THE WEEK'S EVENTS

All PWA Money Has Been Alloted

More than half of projects in current program are already under construction

With the allotment of funds to 115 non-federal projects on Nov. 19 the Public Works Administration virtually exhausted the appropriation granted it by the last Congress. As of that date PWA had left only $105,000 available for non-federal allotments and $800 for federal projects.

During the period between June 22, 1938, when the allotment of funds started, and announcement of the final list of projects, PWA approved 1,059 grants to various federal agencies for a total of $199,999,000 as well as 6,333 allotments to municipalities and other public bodies with aggregate loans of $58,431,000 and grants of $665,465,000. The total estimated construction cost of the non-federal program alone is $1,477,995,000.

Nearly 58 per cent of all the projects in the current PWA program were under construction Nov. 23. About 3,222 non-federal projects were under way, with a construction value of more than $788,000, while work was started on all the federal projects. Work has been completed on a few projects.

With all funds allotted (except such minor amounts as may become available through rescissions) PWA has on file additional non-federal applications for construction projects totalling about $1,000,000,000 in cost. While the administration has made no move toward requesting additional funds it is known that there is some sentiment within Congress to continue PWA activity.

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Construction Bids Called On Mahoning Dam

Bids will be opened December 17 by the U. S. Engineer Office at Pittsburgh for construction of Mahoning Dam on Mahoning Creek, a tributary of the Allegheny River. The dam will be of the concrete gravity type with a crest length of 993 ft. and a maximum height of about 160 ft. above stream bed. It will be located 4 miles northwest of Dayton, Penna. The spillway will be controlled by five crest gates. The storage capacity will be 75,400 acre-feet, all of which will be used for the control of floods.

Mahoning Dam is part of the general plan for the control of floods in the Pittsburgh region.

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West Indian Landslide Kills Hundreds

An area of 64 square miles in the British West Indian island of St. Lucia has been ordered evacuated after landslides Nov. 22 and 23 caused known deaths totalling 56 and left 250 people missing. Press reports state that a mountainside slid into a valley so rapidly that people living there had no opportunity to escape.

No precise information as to the cause of the landslide is yet available, but Geological Survey and Smithsonian Institute geologists in Washington who are familiar with the terrain in St. Lucia are of the opinion that erosion of the mountainside left too steep a slope and that part of the mountain then moved down. They believe the slip is very similar in its causation to the California slide of last summer.

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Narrows Bridge Contract At Tacoma Awarded

A $5,950,000 contract for construction of a toll bridge across the Narrows near Tacoma has been awarded by the Washington State Toll Bridge Authority to the General Construction Co. of Seattle, the Pacific Bridge Co. of San Francisco, and the Columbia Construction Co. of Bonneville, Ore. Bids were opened Sept. 27, but award was delayed while the state met RFC regulations in order to secure a loan to supplement a PWA grant. The loan will be retired from tolls.

Crossing a narrow neck of Puget Sound, the Narrows bridge will connect Tacoma with the Olympic peninsula. With an overall length of 5,560 ft., it will have a 2,600-ft. suspension span and side spans of 1,300 ft. It will carry a 26-ft. roadway.

Condemnation Urged For Housing Sites

Moses says parks and schools should be included in housing projects in New York

Park Commissioner Robert Moses of New York City has suggested unofficially a program by which New York City might utilize its share of the $300,000,000 of state loans made available by a constitutional amendment approved by the voters Nov. 8. Moses assumes that the city would obtain $200,000,000 of this amount.

Moses urged a number of changes from existing housing procedure in carrying out this program. He wants to see about 10 per cent of the housing funds utilized to provide public improvements such as schools and utilities. He attacked the policy of keeping housing sites secret until options have been secured on the land. He urged that proposed sites be revealed and subjected to public criticism and the land then acquired by condemnation.

Administrative changes proposed included the use of 50 per cent WPA relief labor on housing projects and abolition of the present New York City Housing Authority; Moses would substitute for the authority an *ex officio* board of heads of city departments.

In order to service the loans obtained from the state, Moses would impose a 1-cent tax on cigarettes. This he estimates would furnish revenue which, together with the annual grant from the state also provided for in the new constitutional amendment, would permit servicing the loan and would in addition provide funds for the general city treasury to take the place of the taxes previously obtained from the tenement areas to be torn down. He suggested that a tax on housing projects based on the assessed value of the former tenements be paid into the general funds out of housing funds.

Moses suggested ten housing projects in various congested parts of the city to which he thought the state loans ought to be applied. In addition, he proposed five other projects costing about $90,000,000 which could be carried out as limited dividend projects by insurance companies.

Man-Hour of Work Costs One Dollar

Bureau of Labor Statistics finds each 45 cents of PWA money creates hour of employment

One man-hour of employment, direct or indirect, is created by each 45 cents which the Public Works Administration contributes to non-federal PWA projects. On the basis of total expenditure, one man-hour of employment is provided for every dollar of project cost.

These findings were reported Nov. 28 by the Bureau of Labor Statistics of the Department of Labor on the basis of a five-year analysis.

Streets and highways

Largest amount of employment per dollar expended was furnished by street and highway construction projects. On such projects, for each million dollars expended about 1,150,000 man-hours of work were created. Of this, about 500,000 was at-the-site employment, while the remainder was indirect employment in the fabrication of materials. Industry and trade received $482,000 in material orders for each million dollars expended on street and highway projects.

The ratio of employment to expenditure on other types of projects was found to vary in the following order, from highest to lowest: water supply, reclamation, residential building construction, sewage disposal, non-residential building construction, diesel power and light, steam power and light.

The ratio of industrial orders to expenditure ranges from $776,000 for each million dollars spent on diesel power and light plants, to $457,000 on residential building construction. The ratio on different types of projects was in the following order: diesel power and light plants, steam power and light plants, water supply, non-residential buildings, sewage disposal, streets and roads, reclamation, residential buildings.

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Two Housing Projects Announced in New York

Somewhat scaled down from the plans announced last month (*ENR* Nov. 10 1938 p. 571), plans have been announced by Mayor LaGuardia of New York City for two new housing projects there. One, to cost about $2,225,000, will be located in a slum area in Queens and will probably consist of three-story buildings surrounding a small park. It will contain about 500 dwelling units, housing 2,000.

The second project, to cost about $10,000,000, will be built in a slum area whose location was not disclosed. It will contain 1,500 apartments housing 6,000 people.

Last month, the Mayor announced that the city was planning two new projects, one of which would be a $12,000,000 USHA-financed project and the other a $7,500,000 project financed by the city.

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Water Supply Urged For Westchester

Two plans to provide Westchester County, suburban area near New York City, with an adequate future water supply, have been filed with the Board of Supervisors by the Westchester County Water Commission. The report is based on a study made by the commission and its consulting engineers, Malcolm Pirnie, James F. Sanborn, and W. W. Young.

One plan calls for the expenditure of $22,343,000 on an independent water supply for the county. It involves a dam and reservoir on Conocus Creek near Peekskill, development of the Oscawanna Brook and construction of a purification plant and aqueduct. It would provide 38 m.g.d. At a later stage, Clove Creek in Putnam County would be developed, bringing the capacity to 46 m.g.d. The county now uses 40 m.g.d.

A second plan calls for the expenditure of $9,900,000 on an aqueduct and filtration plant connected with the New York City water supply and the purchase of water from the city at a lower rate than is now in effect.

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Dedicate St. Anthony Falls Hydraulic Laboratory

Completion of the St. Anthony Falls hydraulic laboratory of the University of Minnesota, under construction since 1936, was marked by dedication ceremonies Nov. 17 and an "open house" on the three succeeding days. The site is on Hennepin Island where the city formerly utilized hydro power to pump domestic water supply. The city transferred its water rights to the University, and the Northern States Power Co. granted easements on adjoining property for use in developing the project.

The laboratory, a PWA project, is of reinforced concrete and stone masonry and is carved from the stone ledge forming the head of the falls. L. G. Straub, professor of hydraulics, University of Minnesota, was consulting engineer.

WPA Employment Begins to Drop

Employment by the Works Progress Administration reached a peak of 3,263,000 during the week ending Nov. 5 and has been declining since then. For the following week the figure was 3,258,000, and for the week ending November 19 it was 3,244,000. This downward tendency is expected to continue indefinitely.

Two factors are mentioned by WPA officials as responsible for the downward tendency in the relief load: increasing business activity, with consequent improvement in private payrolls, and the rapidly-growing primary and secondary employment in connection with the 6,000-odd PWA projects approved since last June.

No man, WPA officials say, has been discharged from WPA work as an economy move—all separations have been voluntary.

Too many variables are concerned to permit any prediction of the rate at which WPA reductions will be affected; it is anticipated however, that funds now on hand will last until about March 1.

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Prefabricated Buildings For Farms Shipped

First shipments of the prefabricated metal farm buildings developed jointly by Tennessee Coal Iron & R.R. Co. and the Farm Security Administration, were made Nov. 21. T.C.I. shipped out twelve units to sites selected by FSA in Alabama, Georgia and South Carolina. Each unit includes a dwelling, barn, chicken house, outdoor pantry, and sanitary privy.

The prefabricated buildings were developed by joint design and research of the T.C.I. and the Farm Security Administration. FSA then asked for bids and T.C.I. was awarded the contract to supply twelve of the units.

The dwelling contains five rooms. About six tons of steel are used for the foundation structure, frame, sides, roof, exterior door, window trim and fireplace. Floors and doors are of wood, and insulating wallboard is used in finish for walls and ceilings.

Buildings are erected by bolting together preformed panels. The foundations are prefabricated from two steel channel sections, shop welded to a steel footing plate and coated with asphalt. Central heating is provided by a steel fireplace with jacket inclosure.

The twelve units now being shipped are to be used on tenant security projects of the FSA. It is estimated that the five-room dwelling, erected, will cost $1,700 to $1,900.

Fairchild Aerial Surveys, Inc.

CHICAGO'S NEWEST TREATMENT PLANT NEARS COMPLETION

THE WORLD'S LARGEST activated sludge plant, the Southwest Sewage Treatment Plant of the Sanitary District of Chicago, is rapidly nearing completion. Design capacity is 400 m.g.d.—enough to handle the waste of a population of 1,250,000, plus stockyard and packing wastes, the equivalent of an additional million. Above are shown the aeration tanks, flanked by thirty-two 125-ft.-diam. clarifiers. Sludge is to be disposed of by incineration. Incinerators are designed to handle 100 tons of filter cake per hr., and to generate as a by-product 100,000 lbs. of steam in the same period of time.

Chicago Utility Company May Spend $75,000,000

In announcing the latest steps in its program of financial adjustment, the Commonwealth Edison Co. of Chicago announced that $14,000,000 for future construction is being reserved from money obtained by the sale of new securities. Because of increasing demand for service in Chicago and its outlying area, $75,000,000 in capital expenditures may be necessary in the next two years, Commonwealth Edison announced.

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Road Exit Limit Upheld by Court

The right of the city of Fort Smith, Ark., to build a center curb down the middle of a four-lane highway in the city, was upheld by the Arkansas Supreme Court in reversing a decision made by Sebastian County Chancery Court.

The county court had granted the request of a tourist camp operator for an injunction against the city. The camp operator is located in the middle of the block and held that forbidding drivers to cross over would prevent access to his property.

The supreme court pointed out that "there can be no doubt that the city has the power and the duty to make reasonable provision for the safety of persons and property using its streets . . . An unbroken middle curb separating a four-traffic lane is proper construction and reasonably necessary . . ."

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Rent Control Law Upheld in New York

The Minkoff Law, a New York State act passed by the 1938 Legislature, received tacit approval from the state Court of Appeals when the court halted an effort to evict a New York City tenant from his apartment after he had refused to pay a $5 a month rent increase.

The Minkoff Law prevents owners of old-law tenements in New York City from charging rents any higher than those received between Sept. 30, 1937, and March 1, 1938, if the building contains any violations of the tenement house law. An apartment house operator had sought to obtain increased rent, and the tenant, obtaining a certificate of violations, relied on the Minkoff bill in his refusal to pay the increase.

In its decision, the court gave no explicit opinion on the constitutionality of the law.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

SUFFICIENT data on the slide at Fort Peck Dam will be obtained by the latter part of January, it is believed, to permit the board of engineers which is investigating the accident to undertake its final studies. The board met at Fort Peck last week. Test borings are still going on and will be continued for the remainder of the year.

THE STATE of Georgia will get no more PWA grants until it removes its constitutional provision against borrowing, so that it can furnish its share of the cost of projects, the President said at a press conference last week. The allotment for a $4,000,000 expansion program at the Milledgeville State Hospital for the insane would be the last, he said. This project was arranged through an RFC loan secured by rentals.

The next day Governor Rivers of Georgia announced he would place before the state Assembly a program of legislation to meet the President's objections.

AT THE CLOSE OF BUSINESS Nov. 25, total federal expenditures for the fiscal year which began July 1 exceeded those of the corresponding period of last year by $561,000,000. A month ago expenditures were only $388,000,000 greater than the previous year.

ALLOCATION to the Civil Aeronautics Authority of PWA funds amounting to $6,300,000 for construction of Gravelly Point airport in the District of Columbia has been approved by the President, ending a 12-year deadlock over a new airport for the nation's capital. The allotment provides for establishment of a landing area on the Virginia side of the Potomac River and for construction of hangers and terminal and administrative buildings, including the offices for the Civil Aeronautics Authority.

ANOTHER ALLOTMENT, to the National Resources Committee, provides $100,000 for study of land and migration problems in the northwestern states. The completed survey will include recommendations on fundamental land and water programs and projects of the various federal and state agencies. The purpose of the survey is to assure that normal and emergency public expenditures in the area furnish the most desirable projects.

Escaping Sewage Gas Caused Dayton Blast

Explosion which damaged sewage disposal plant was due to gas escaping through traps

Escape of sewage gas through the blowing of U-tube water-seal traps in the gas line was the most probable cause of the explosion which badly damaged the sewage disposal plant at Dayton, Ohio, on Nov. 12 (*ENR*, Nov. 17, 1938, p. 599), according to the findings of E. Sherman Chase and Arthur L. Shaw of the firm of Metcalf & Eddy, designers of the original plant, who examined the plant Nov. 13-14. The traps through which the gas is believed to have escaped had been installed in changes made by the plant operators subsequent to the completion of the plant in 1928. Igniting of the gas is thought to have been by sparks from a small motor used in test work at the eastern end of the gallery where certain evidences indicated the explosion started.

The explosion occurred at 5:20 a.m. in the enclosed operating gallery between two batteries of Imhoff tanks. The night operator had made his last regular trip through the gallery at 4:30 a.m., at which time he observed nothing out of the ordinary.

Damage to the plant

Major damage took place in the operating gallery and in the control houses at either end through which access to the gallery was obtained and in which the main control valves were located. The reinforced concrete influent and effluent conduits which overhung the gallery at both sides and the reinforced concrete slab which completed the roof of the gallery were almost completely demolished. The brick walls of both control house superstructures were thrown outward, allowing the concrete roof slabs to fall down and resulting in considerable damage to the electrical sluice-gate operating mechanism, air compressors, and other equipment housed in these buildings.

The lines of sludge, water and gas piping in the gallery were partially demolished. As the roof slab was blown upward, the pipe hangers which supported the main upper lines of pipe tore loose, permitting the pipes to fall carrying other lines with them.

Large sections of the gallery roof slab were hurled into the air and fell onto the upper works of the adjacent Imhoff tanks, breaking down some of the walkways and hand rails, and damaging some concrete at the tops of the gas vents; injury to the Imhoff tanks proper, however, was superficial.

ENR Staff Photo

NEW HEADS OF THE A.G.C.

Guy F. Atkinson (*left*) and H. P. "Pat" Zachry are shown congratulating each other at Excelsior Springs, Mo., just after they had been nominated as president and vice-president at large, respectively, of the Associated General Contractors of America for 1939 at the fall board meeting Nov. 16. Atkinson, head of his own contracting firm in San Francisco, is one of the group building the Grand Coulee Dam. He is vice-president at large of the A.G.C. for the current year. Pat Zachry, highway contractor of Laredo, Tex., is vice-president for Zone 5. Both take office at the coming annual convention to be held in San Francisco next Mar. 5-11.

Concussion and falling debris broke some 2,000 panes of glass in the sludge bed glassovers. A few windows were broken in the detritus and administration buildings and a few roof tiles were broken by falling debris.

Cause of the explosion

Messrs. Chase and Shaw conclude there can be but little doubt that the explosion was the result of the ignition of sewage gas escaping in some manner from the system in which it is collected. Gas generated in the digestion compartments of the Imhoff tanks passes up into the gas vents where it is collected in cast iron gas domes. The domes are connected to lateral pipes which are carried through the tank walk into the gallery and thence into a gas main running lengthwise of the gallery and continuing on the gas compressor house and storage tanks.

Damage to structures and equipment by the explosion has made it impossible to determine beyond question either how the gas escaped or how it became ignited, and the exact circumstances may never be known. Nevertheless careful investigation revealed certain conditions which might have been responsible.

All possible ways in which gas might have escaped into the gallery were investigated including leaking joints, broken pipe and the like, with the conclusion that the gas most probably came from one or more of the numerous U-tube water seal slurry traps which had been placed just inside the gallery wall on each lateral gas pipe. The operators had found that the special water seal flame traps which had been provided in the original design required frequent cleaning due to fouling with material carried over with the gas from the gas domes. Therefore, they changed the piping, which had been originally designed to have no openings of any kind within the gallery, by adding 30-in. U-tubes with open ends from which condensate and other excess liquor drained into the gallery gutter. It is known that one or more of these slurry traps have wholly or partially blown from time to time permitting gas to flow or bubble through into the gallery. One such instance occurred within the past three or four week, requiring the refilling of the water seal. It follows that the most probable source of escaping gas was the blowing of one or more of these seals after the night operator's last trip through the gallery, permitting gas to pour into the gallery through 2-in. pipe. Apparently this was more than the ventilators in the gallery skylights could carry off.

The possibility of blowing slurry trap seals was increased by the fact that the cast iron gas domes, which had been designed to stand loosely in the gas vents so as to tilt in the event that gas pressures exceeded 21 in. had been grouted in by the operators because of the annoyance and inconvenience caused by the escape of foam and scum onto the surface of the sedimentation compartment by oozing up between the bottom edges of the gas domes and the concrete diaphragms on which they rested.

The hazard was also somewhat increased by the deepening from 18 in. to 21 in. of relief seals near the gas domes, designed to blow off into the Imhoff tanks and thence to open air. Only a 9-in. differential was left between this seal and the 30-in. slurry trap seals in the gallery.

As in the search for the source of escaping gas, the destruction of evidence by the explosion prevented conclusive discovery of the source of the spark or flame which ignited the gas. All possible sources were given careful consideration by the investigators, and, although the spark causing the explosion could have been in an electric light socket, the burden of suspicion was found to lie upon one of two fractional horsepower motors which were running at the time in connection with

a small experimental high rate trickling filter model which had been installed near the east end of the gallery. The motor in question was slip-ring brush operated, and although the condition of the rings indicated that the brushes were making good contact and had not been sparking sufficiently to burn or score the rings, slight sparking is likely to occur in such motors at all times.

Emergency alterations are being made to the plant to permit partial treatment of sewage during repair of the damaged units. These will be in operation by Dec. 1. The work of clearing away debris is progressing rapidly with WPA assistance, and concrete placing has begun.

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Flood Danger Arises From Forest Fires

Three areas which suffered heavily in the floods of last spring were laid open to special flood danger in the approaching rainy season by forest fires which last week caused great damage in San Bernardino, Ventura, and Los Angeles counties in southern California.

In the canyons of the San Bernardino Mountains more than 7,000 acres were completely burned over, and considerable city water supply area was denuded of protective cover. These canyons pour their flow directly into the city of San Bernardino, the most severely hit in the March floods.

In the watershed of the San Antonio canyon, which did much damage last spring, about 3,000 acres were destroyed, and more than 15,000 acres were denuded in the Santa Monica Mountains, leaving several canyons almost bare. The canyons in this last area are short but precipitous and are subject to severe flash floods.

The Los Angeles county flood control commission has already undertaken surveys and is moving equipment into the danger area to construct emergency check dams and debris basins.

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Missouri Court Denies Flood Damages

The Missouri Supreme Court, Division No. 1, has reversed a decision awarding damages to a Carroll County farmer against the Massman Construction Co. of Kansas City. The farmer had charged that a dike built by the company at Sheeps Nose Bend on the Missouri River in 1930 had so narrowed the channel that it caused the river to back up and overflow his land in the flood of 1937. A county court jury awarded him damages of $2,017 in June 1937.

The dike was built by the Massman Co. for the federal government, and in defending the suit the company pointed out that the government had accepted and approved the dike. The supreme court decision held that the farmer "wholly failed to produce sufficient evidence to elevate his case from the field of guess."

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State Fire Control System To Aid Flood Control

The Pennsylvania department of forests and water is planning to utilize its fire control radio system for the control of floods. Whereas operators are now stationed throughout the state only during the forest fire season, they will in future be kept permanently stationed at important points to report flood levels. In addition, the radio system will furnish daily weather reports from all parts of the state.

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Radio Program Planned On Conservation

The Department of the Interior is planning to produce a series of 26 radio programs on the subject of conservation, entitled "What Price America." The program will report in dramatized form the history of conservation in terms of the discovery, exploitation, and use of America's resources. The story will begin with the settlers in 1620 and continue up through 1939.

It is expected to begin the program some time in January 1939, but definite dates and stations have not yet been determined.

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San Francisco Chamber Promotes Building

A construction industry section has been organized in the San Francisco Chamber of Commerce with the cooperation of the local office of the Federal Housing Administration. Including all phases of the construction industry, from real estate men to interior decorators, the new section is designed to encourage and promote all types of building.

As its first activity, the section has organized a city-wide drive to "Modernize in Time for 1939" tied in with the forthcoming Golden Gate exposition and the FHA financing plan. The program is being pushed by means of advertising of members, a combined newspaper advertising campaign, and a billboard and radio program sponsored by the section. The radio program, entitled "New Homes for Old," is addressed to women and provides advice in non-technical language on building problems.

Canadian Engineers Join Forces

Engineering Institute and Professional Engineers in Saskatchewan form agreement

A cooperative agreement between the Engineering Institute of Canada and the Association of Professional Engineers of Saskatchewan was signed in Regina, Oct. 29. The event climaxes efforts of many years to find a means of cooperation between the voluntary engineering society and the various provincial licensing bodies recognized in law.

The agreement provides for common membership and a joint set of officers for the association and for the Saskatchewan branch of the institute. All members of the association automatically become corporate members of the institute in the class to which their qualifications entitle them. For the next year institute members may join the association without payment of entrance fees, and a similar provision applies to institute members moving into Saskatchewan in the future. Joint dues will be collected for the association and a part of the payment will be remitted to the institute.

Agreements are now in process of development between the institute and other provincial associations. The arrangement was facilitated in Saskatchewan by the fact that there is only one branch of the engineering institute in that province, whereas in other provinces there are two or more branches.

The signing of the Saskatchewan agreement was made the occasion of a ceremony at which, in addition to local engineers, President J. B. Challies of the institute, as well as General Secretary L. Austin Wright and F. Newell, chairman of the institute's professional affairs committee, were present. Speeches by Challies and President J. W. D. Farrell of the Saskatchewan association were broadcast over a nation-wide hook-up.

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Railway Held Responsible For Low Bridge Accident

A coroner's jury at Charney, Que., on Nov. 10 held that the Canadian National Ry. was "criminally responsible" for the death of a 16-year-old boy who was killed when a truck on top of which he was riding passed under a low railway viaduct. The boy's head struck the viaduct and he was knocked to the ground.

The jurors condemned the underpass as "an imminent danger to traffic."

TVA Investigators Take Up Power

Experts for power companies question economic justification for TVA power yardstick

The TVA power yardstick was strongly condemned last week at hearings before the Congressional committee investigating the Tennessee Valley Authority. The hearings were resumed in Washington Nov. 17, and since that time the committee has devoted its attention almost exclusively to TVA efforts to build a market for its power by taking over the distribution systems and customers of local electric power companies.

Speaking for the power companies, Edward L. Moreland, dean of the engineering department of M.I.T., stated that the TVA power program will cost the taxpayers $10,352,000 a year in subsidies after the 11-dam system is completed if the TVA adheres to its announced rates. His figures were challenged by Francis Biddle, counsel for the committee, who pointed out that Dean Moreland used 3.5 per cent interest rate whereas the TVA pays only 2.7. Biddle also challenged many other items in the Moreland estimates.

Dean Moreland stated that 65.2 per cent of the cost of TVA dams should be allocated to power instead of 52 as in the TVA figures.

Cost allocations

Similar attacks on the TVA yardstick were made by C. W. Kellogg, president of the Edison Electric Institute. He stated that TVA figures are unfair as compared with the costs of private development because the latter can charge none of the cost of a dam to navigation even though navigation is a large beneficiary. He also noted that TVA pays no taxes, interest during construction, nor preliminary losses during the load building period. Kellogg also criticized the TVA rates as too low, going into much detail to indicate that they are not borne out by apparent costs.

Power policy attacked

The administration's power policy was attacked by Wendell L. Willkie, president of the Commonwealth & Southern Corp., holding company for most of the electric utilities in the TVA region. Willkie said that the TVA, with the backing of the Public Works Administration, was attempting to force the utilities to sell at the TVA price by threatening to build duplicating systems. This policy, he said, had so shaken public confidence in utility securities as to make it impossible for the utilities to finance expansion.

Willkie said that the soundest policy would be for the government to get out of the power business, which he considered unconstitutional competition with its citizens, but that if those administrating the TVA would not agree to this they should agree to buy the utility properties in the TVA area in their entirety at a fair price and should clearly define the area in which they intend to operate. To this end, Willkie suggested that the Securities Exchange Commission be authorized to set a fair value on the properties of the Tennessee Electric Power Company, part of whose system the TVA is now trying to buy. He said he did not want to sell but is willing to abide by the finding of the S.E.C., appointed by the present administration, because it has a high sense of public obligation.

Economic recovery delayed

"It is not merely a question of protecting investors who have put money in good faith in well managed public utilities under public regulation", said Willkie, "but a matter of getting rid of the fear in the capital market which has held back new investment and prevented full economic recovery. I do not believe the country is going over to public ownership, but even if it does there there will be a long transition period, at least ten or fifteen years, during which billions of new capital must be lured from investors if the needs are to be met."

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Removable Building Planned For New York Fair

The building to be erected by the U.S.S.R. at the New York World's Fair opening next spring is being erected in such a way that it can be disassembled after the fair closes and shipped in sections to the Soviet Union to be re-erected there as a permanent structure, it has been announced. The 70,000 sq.ft. building will require more than 1,200 tons of structural steel; even a 170-ft. pylon is to be so constructed that it can be re-erected.

This plan requires the use of a steel structure heavier than that required by the fair authorities so that it can carry a permanent concrete load. Bolting is used instead of riveting or welding, and a minimum use is made of stucco and plaster; panels of gypsum and asbestos which can be fastened dry will be used instead. The original elevators and escalators as well as the air conditioning plant will be re-installed in the permanent building in the Soviet Union.

Hegeman Harris Co. of New York are the contractors on the project, and the American supervising architects are Pomerance & Breinnes.

Competing Plant Gets PWA Grant

Columbus, Miss., is unable to buy utility and gets grant to build competing system

PWA Administrator Harold L. Ickes on Nov. 22 announced that a pending grant of $126,000 to the city of Columbus, Miss., for a municipal electric distribution system is now effective. Efforts of the city to purchase existing facilities from the Mississippi Power Co. have been unsuccessful and money will be made available to the city immediately for preliminary expenses.

Some fifty PWA power allotments are now being held up in accordance with the promise made last summer by Sen. Barkley, during the debate on the relief appropriation, that no more PWA money would be made available for compentitive power projects until bona fide offers to purchase existing facilities had been made.

Two cities—Vandalia, Mo., and Smithville, Tex.—have had such offers accepted and are proceeding with purchase arrangements. Other decisions must be made in the near future since construction of PWA projects under the current program must be started not later than Jan. 1, 1939.

The history of the Columbus project is briefly summarized as follows: On July 7, 1938, PWA approved the allotment, subject to the condition already mentioned. Subsequently the city offered the company $232,000 for its system, which serves 2,500 customers. This offer was refused by the company, which asked $536,366 for the properties. Both parties then filed briefs with Administrator Ickes in support of their respective positions. After due consideration and investigation the administrator suggested that $269,000 would be a fair valuation. This figure was accepted by the city, but not by the company.

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Biggest Water Turbines Put Under Contract

Contract to furnish three 150,000-hp. turbines, the largest in the world, for Grand Coulee Dam, was awarded Nov. 25 to the Newport News Shipbuilding & Drydock Co. of Newport News, Va. The company's bid, lowest of five, was $1,477,000 for the three vertical-shaft hydraulic turbines.

The turbines, which will be put in the left power house at the downstream toe of Grand Coulee Dam, will drive the initial installation of three main generating units. Ultimately, each of the two power houses will contain nine of these units, to provide 2,700,000 hp.

LaGuardia, Engineer On Sardis Dam, dies

C. E. Weaver, Georgia rail official, and C. M. Daily, St. Louis water commissioner, also dead.

Major John B. LaGuardia, project engineer for the U. S. Engineers on the Sardis Dam in Mississippi, died in Vicksburg, Nov. 24. Stationed at Sardis since 1936, LaGuardia had previously been executive assistant to the district engineer at Vicksburg and earlier spent eight years in the finance division of the Chief of Engineers in Washington.

C. E. Weaver, general manager of the Central of Georgia Ry., died in Savannah, Nov. 27 at the age of 61. Weaver had been general manager since 1933 and was previously assistant general manager and assistant chief engineer. After his graduation in 1899 from the Sheffield Scientific School at Yale, Weaver spent twelve years at railway work in Mexico. Later he went with the Illinois Central R.R. as road-master at New Orleans, and later as district engineer of the southern lines of the company. From 1933 to 1936, Weaver was on leave of absence from the Central of Georgia, serving as southern regional director of railroads under the federal coordinator.

Cornelius M. Daily, 62, vice president and chief engineer of the Missouri Engineering and Construction Co. and former city water commissioner of St. Louis, died at Jacksonville, Ill., Nov. 25. He had been supervising a water works improvement project at Jacksonville. Daily was a graduate in 1903 of the Missouri School of Mines and after two years work with the federal government and several years in private work, he began to practice at Parmi, Ill. as a member of the firm of Daily & Beckenheimer. In 1911 he went with the Pitzmans Surveying and Engineering Co. and in 1913 he joined the St. Louis water department as assistant engineer. In 1917 he became engineer in charge of supply and purification and held that post until 1925. He left the city service then to join the Missouri firm but resigned in 1933 to become water commissioner. Three years later he re-entered private business.

C. W. Allen, Montreal builder connected with the Foundation Co., Ltd., died Nov. 20 in Montreal, at the age of 61. Allen graduated from the University of Toronto as a civil engineer and, after service in the Boer War, practiced in Toronto. He served in the Canadian Engineers during the Great War.

John S. Dennis, former head of the department of colonization and immigration of the Canadian Pacific Ry., died in Victoria on Nov. 26 at the age of 82. Three weeks before his death, Dennis had received the Sir John Kennedy gold medal of the Engineering Institute of Canada. He was a past president of the Canadian Society of Civil Engineers and of the American Society of Irrigation Engineers. Dennis began his professional career in 1879 as surveyor and engineer for the Hudson Bay Co. He joined the Canadian Pacific in 1902 as superintendent and chief engineer in charge of the irrigation system at Calgary. He served during the Great War with the rank of colonel and was for some time Canadian Red Cross commissioner in Russia.

James H. Jourdan, who retired last year as chairman of the board of the Brooklyn Union Gas Co., died last week in New York City at the age of 74. Jourdan started with the Fulton Municipal Gas Co. as a laborer and studied engineering at night. When the Brooklyn Gas Co. was formed in 1895, by the merger of the Fulton Co. and several others, Jourdan became chief engineer of the western division, then engineer of construction, and later chief engineer. In 1910 he was made vice president and director and became president in 1914, a post which he held until 1935.

Frank D. Porter, senior engineer in the New York State Department of Public Works, died Nov. 17 at the age of 58. Porter entered the service of the state in 1909 when he became assistant engineer for the New York State Water Supply Commission and a few months later assistant engineer of the New York State Barge Canal. He graduated from Colgate in 1902 and Rensselaer Polytechnic Institute in 1906.

• • •

Big Highway Letting In Mississippi

With $6,667,000 immediately available for a highway building program, the Mississippi State Highway Department is planning to advertise $311,000 of this work for a letting on Nov. 29, and the balance will be placed under contract in three subsequent monthly lettings. The department recently received a grant of $3,000,000 from the Public Works Authority to meet 45 per cent of the cost of a highway construction program.

The work involved in the program includes about 170 miles of grading and drainage and 270 miles of various types of pavements, including Portland cement, concrete and bituminous types.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY ENGINEERING NEWS-RECORD, IN NOVEMBER, 1938

Engineering News-Record *reports projects of the following minimum costs: Waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

Four Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States Nov. 1938	United States Eleven Months 1938	United States Eleven Months 1937	Canada
Public Works										
Waterworks	655	1,246	1,440	1,012	1,288	541	**6,182**	100,375	96,695	807
Sewerage	945	3,927	1,297	3,823	2,897	1,997	**14,886**	111,054	88,838	27
Bridges, public	702	1,867	1,967	1,165	2,032	436	**8,169**	96,669	115,570	362
Earthwork and waterways	1,299	1,113	1,936	439	6,622	2,712	**14,121**	246,876	94,095	2,168
Streets and roads	2,485	15,979	8,113	4,394	13,390	7,001	**51,362**	587,719	380,652	308
Buildings, public	3,283	21,827	7,637	13,448	12,051	7,347	**65,593**	400,438	287,719	50
Unclassified, public	526	2,405	2,651	2,109	1,443	1,818	**10,952**	168,451	126,844	337
Total public	**9,895**	**48,364**	**25,041**	**26,390**	**39,723**	**21,852**	**171,265**	**1,711,582**	**1,190,413**	**4,059**
Federal government (included in above classifications)	**2,415**	**6,999**	**4,982**	**1,388**	8,773	5,528	**30,085**	328,395	181,568	.....
Private										
Bridges, private	.....	543	724	.....	750	.....	**2,017**	7,568	7,859	.....
Buildings, industrial	195	735	618	2,015	3,255	406	**7,224**	135,780	463,035	398
Buildings, commercial	**2,140**	22,451	1,650	2,311	1,470	1,898	**31,920**	518,291	425,503	800
Unclassified, private	80	148	1,408	619	2,256	86	**4,597**	79,460	151,780	778
Total private	**2,415**	**23,877**	**4,400**	**4,945**	**7,731**	**2,390**	**45,758**	**741,099**	**1,048,177**	**1,976**
Total Engineering Construction										
November, 1938 (4 weeks)	**12,310**	**72,241**	**29,441**	**31,335**	**47,454**	**24,242**	**217,023**	.....	.....	**6,035**
October, 1938 (4 weeks)	16,819	82,104	28,348	32,150	45,646	30,831	235,898	.....	.....	10,161
November, 1937 (4 weeks)	5,421	87,590	12,440	26,357	19,721	14,052	**165,581**	.....	.....	9,779
Eleven Months — 1938	**124,387**	**945,219**	**251,678**	**328,394**	**434,693**	**368,310**	.....	**2,452,681**	.....	**79,675**
Eleven Months — 1937	**103,345**	**991,337**	**219,504**	**385,993**	**318,795**	**219,616**	.....	.....	**2,238,590**	**125,320**

CONTRACTS AND CAPITAL

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	November 1937 (4 wks.)	November 1938 (4 wks.)	% Change	Eleven months 1937 (47 wks.)	Eleven months 1938 (47 wks.)	% Change
Total Construction Volume	$165,581	$217,023	+31.0	$2,238,590	$2,452,681	+9.6
Private	53,234	45,758	−14.0	1,048,177	741,099	−29.0
Public	112,347	171,265	+52.0	1,190,413	1,711,582	+44.0
Federal	6,712	30,085	+349.0	181,568	328,395	+81.0
Total New Productive Capital	$36,840	$207,596	+463.0	$2,110,362	$3,560,046	+69.0
Private Investment	36,840	99,081	+169.0	956,074	948,638	−1.0
Federal (non-federal work)	.....	108,465	.....	408,065	1,467,713	+260.0
Federal (federal work)	.....	50	.....	746,223	1,143,695	+53.0
FHA Mortgages Selected for Appraisal	$37,299	$77,285*	+107.0	$557,125	$920,108*	+65.0

* *Preliminary.*

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	December 1937	December 1938	% Change	Change November to December 1937 Nov.	1937 Dec.	1937 %	1938 Nov.	1938 Dec.	1938 %
ENR Construction Cost Index, 1913 = 100	241.05	234.89	−2.6	241.40	241.05	−0.1	234.40	234.89	+0.2
ENR Building Cost Index, 1913 = 100	200.45	196.07	−2.2	200.30	200.45	−0.1	195.58	196.07	+0.3
ENR 20-CITIES AVERAGE									
Common Labor	$0.678	$0.682	+0.6	$0.678	$0.678	0	$0.682	$0.682	0
Skilled Labor (Av. 3 Trades)	1.391	1.427	+2.6	1.382	1.391	+0.7	1.427	1.427	0
Bricklayers	1.480	1.514	+2.3	1.480	1.480	0	1.514	1.514	0
Structural Ironworkers	1.435	1.479	+3.1	1.425	1.435	+0.7	1.479	1.479	0
Carpenters	1.257	1.288	+2.5	1.242	1.257	+1.2	1.288	1.288	0
Cement, per bbl.	$2.53	$2.56	+1.2	$2.51	$2.53	+0.8	$2.57	$2.56	−0.4
Reinforcing Steel, cwt.	2.91	2.48	−14.8	2.91	2.91	0	2.48	2.48	0
Struct. Steel Shapes, Pitts.	2.25	2.10	−6.7	2.25	2.25	0	2.10	2.10	0
Sand, per ton	1.23	1.23	0	1.22	1.23	+0.8	1.24	1.23	−0.8
Lumber, 2x4 Fir per M ft.	36.02	32.67	−9.3	36.09	36.02	−0.2	32.38	32.67	+0.9
Lumber, 2x4 Pine, per M ft.	31.35	29.21	−6.8	31.88	31.35	−1.7	28.59	29.21	+2.2
Brick, common, per M.	14.11	13.86	−1.8	14.12	14.11	−0.1	13.87	13.86	−0.1
Ready-Mixed concrete, c.y.	7.42	7.14	−3.8	7.42	7.42	0	7.13	7.14	+0.1
Struct. Clay Tile, 3x12x12	72.89	74.48	+2.2	72.95	72.89	−0.1	74.08	74.48	+0.5
Paving Asphalt, cars, ton	16.99	14.16	−16.7	17.15	16.99	−0.9	14.11	14.16	+0.4

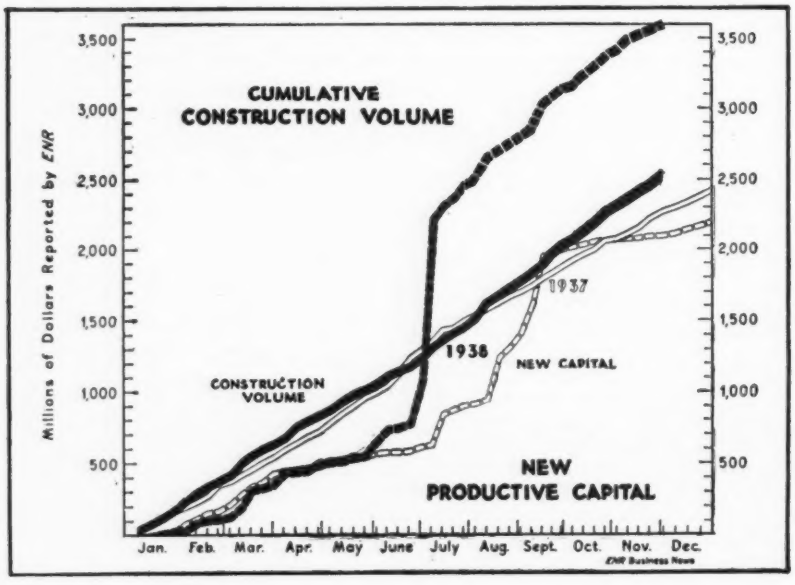
MATERIAL SHIPMENTS . . . BUILDING PERMITS

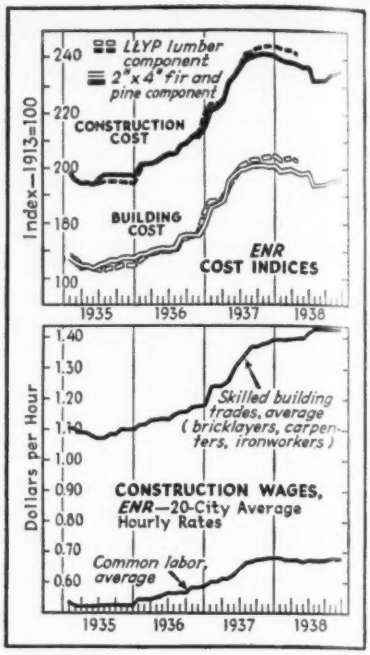
	November 1937	November 1938	% Change	Oct. 1938	% Change Oct. to Nov.
Lumber (% 1929 wk. av.) N.L.M.A.	54.0	62.8	+16.3	65.5	−4.1
Steel (% operating capacity) A.I.S.I.	39.3	60.6	+54.2	50.6	+19.9

	October 1937	October 1938	% Change	Ten Months 1937	Ten Months 1938	% Change
Fabricated Struct. Steel (AISC) tons	155,923	95,205	−39.0	1,422,018	942,607	−34.0
Cement, thous. bbl. (USBofM)	11,190	12,357	+10.4	101,029	91,670	−9.3
Building Permits, Dun & Bradstreet, (,000 omitted)	$90,712	$97,112	+7.1	$942,583	$968,302	+2.7

RENT INDEX . . . EMPLOYMENT

	October 1937	October 1938	% Change	Sept. 1938	% Change Sept.-Oct.
Rent (Housing) Index, N.I.C.B.	89.2	86.6	−2.9	86.6	0
Trade Unions, % Employed, AFL	88.0	85.0	−3.4	84.0	+1.2
Building Trades, % Employed, A.F.L.	77.0	68.0	−11.7	68.0	0





CONTRACTS

(Thousands of dollars)

	Week Ending Dec. 2 1937	Nov. 24 1938	Dec. 1 1938
Federal	$3,675	$3,945	$10,133
State & Municipal	21,347	33,436	44,457
Total public	$25,022	$37,381	$54,590
Total private	16,658	12,589	13,546
TOTALS	$41,680	$49,970	$68,136
Cumulative 1938 (48 weeks)			$2,520,817
Cumulative 1937 (48 weeks)			$2,280,270

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1937 48 Wk.	1938 48 Wk.
NON-FEDERAL	$1,369,750	$2,452,057
Corporate securities	499,951	354,004
State & Mun. bonds	461,734	630,340
PWA loans, grants	178,126	833,320
RFC loans	29,939	100,344
U.S.H.A. loans	.....	265,054
R.E.A. loans	.....	67,495
Federal Aid-highways	200,000	201,500
FEDERAL	$746,223	$1,143,695
TOTAL CAPITAL	$2,115,973	$3,595,752

FHA MORTGAGES

	Week Ending Nov. 25 1937	Nov. 19 1938	Nov. 26 1938
Selected for appraisal	$7,203	$21,751	$17,800*
Cumulative 1938 (47 weeks)			$920,108*
Cumulative 1937 (47 weeks)			$557,125

* Subject to revision.

ENR INDEX NUMBERS

	Construction Cost 1913	1926	Building Cost '13	'26	Volume '13	'26
Base = 100						
Dec., 1938	234.89	112.87	196.07	105.99	...	...
Nov., 1938	234.40	112.69	195.58	105.71	199	87
Oct., 1938	234.30	112.53	195.48	105.67	217	95
Dec., 1937	241.05	115.65	200.45	108.50	143	63
Nov., 1937	241.40	115.80	200.30	108.35	148	65
1938 (Av.)	235.86	113.34	196.83	106.40	...	...
1937 (Av.)	234.71	112.66	196.15	106.07	172	75
1936 (Av.)	206.42	99.15	172.18	93.14	185	81
1935 (Av.)	196.44	94.43	165.76	89.65	134	59

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Law for Engineers

Sir: I am a regular subscriber to the *Engineering News-Record* for the last twenty years, and over, and I wish to congratulate you on the publication appearing in your issue of Nov. 3, 1938, page 561.

If we had more of these articles which summarize the law on the legal cases of interest to engineers, and if these articles were carefully read by engineers, they would contribute to consolidate the credit given to the engineers all over the country.

PAUL A. BEIQUE
Consulting Engineer
Montreal, Que., Nov. 7, 1938

Expansion Joints

Sir: The experience of the City of Spokane with expansion joints in its concrete bridges may be of interest for its bearing on the issues raised by Mr. Schureman's letter in your Oct. 3 issue, page 453.

The Spokane River flows through Spokane dividing it into nearly equal parts and necessitating numerous bridges. Temperatures ranging from 0 to 15 deg. below zero are common during winter months, while 90 to 100 deg. or more are frequent summer temperatures.

Much bridge building occurred in the period 1905 to 1915 and these bridges were extensively and expensively jointed, usually with sliding plates.

Presently it was discovered that for one cause or another these sliding plates were not sliding, but had become fixed and immovable. This change of condition of the sliding plates did not, however, appear to have any adverse effect upon the bridges. They have functioned for 25 years or more without articulation, quite as well as they did when the sliding plates slid.

This led us, when building the Freya Street Viaduct over certain railroads in 1928 to make it continuous and monolithic from end to end. There are no joints of any kind in its 376 feet length. It abuts against fills of sand and gravel in which the end bents are buried. Unquestionably its deck is stressed in compression in the summer and in tension in the winter. There are a number of scattered fine shrinkage cracks across the deck. That is all.

Neither in the Freya Street Viaduct nor in any other of our bridges have we found that shrinkage cracks cause progressive deterioration in the concrete. The cracks develop, then nothing more happens.

B. J. GARNETT
City Bridge Engineer
Spokane, Washington

Earthwork Computations

Sir: Mr. Pearson's letter on "Earthwork Computations" in the *Engineering News-Record* of Oct. 13, gives an accurate and speedy method of figuring areas of cross sections. The method the writer uses differs from Mr. Pearson's in that the sections are not plotted, and the notes not even reduced, but the areas figured directly from the rod readings. Then by using a ten-bank Monroe Calculator or similar machine it is not necessary to add mentally the two distances together in calculating the areas, but one distance may be placed on the right hand three columns of the keyboard, the other one placed on the left hand three columns, and the two totals added at the end to give the complete area. A ten-bank machine is large enough so that one set of totals will not run into the other one.

An example and description of the complete method is given below using one set of notes from a field book. The upper figures are rod readings and the lower ones distances from the centerline of the dike. With the H. I. known, it is a simple matter to compute the "plus" rod readings for the two shoulders so these are placed above the notes and the page will look like this:

$\frac{+18.2}{9.0}$					H.I. +585.8				$\frac{+18.2}{9.0}$
$\frac{2.6}{50.6}$	$\frac{3.1}{41.7}$	$\frac{3.5}{27.9}$	$\frac{3.3}{12.7}$	$\frac{5.7}{0}$	$\frac{5.6}{9.4}$	$\frac{6.7}{18.7}$	$\frac{6.5}{37.3}$	$\frac{7.1}{46.2}$	$\frac{8.0}{63.4}$

Start at the centerline of the dike on the ground and proceed in a clockwise direction around the whole figure. First shift the multiplication and division lever at the upper right hand edge of the keyboard to division. Place the rod reading, 5.7, on the upper dial of the calculator leaving the lower dial clear. Place 12.7 on the right hand three columns of the calculator and back the machine off until the upper dial reads 3.3. We may leave the distance, 12.7, on the right hand side and place 27.9 on the left hand three columns, and with both distances in the machine run the upper dial to 3.5. For the next step we need 27.9 and 41.7 on the keyboard; we already have 27.9 on the left side so we merely change the right side to 41.7 and run the upper dial to 3.1. Now leave 41.7 on the right side, change the left side to 50.6 and run the upper dial to 2.6. Now leave 50.6 on the left side and change the right side to 9.0. Here we go from a rod reading of —2.6 to +18.2 and it is necessary to run the upper dial from 2.6 to 0, then flip the multiplication division lever to multiplication and run the upper dial to 18.2. Still continuing in a clockwise direction we find that the right hand shoulder of the dike has the same elevation as the left hand so we need not change the machine; however we cross the center line between these points so must flip the lever back to division. Now leave 9.0 on the right side of the keyboard and change the left side to 63.4. As we change from a plus rod to a minus rod between these points we run the upper dial to 0, flip the multiplication division lever to multiplication and run the upper dial to 8.0. Putting the distance first on one side of the keyboard and then on the other we go back to our starting point where the lower dial will read 2663060040234. Placing the decimal gives us 2,663.06 on the left side and 402.34 on the right which added together give 3,065.40 for the double area of the figure and 1,532.70 sq. ft. for the single area.

Directions such as these sound complicated but I have purposely chosen the most difficult case, with the zero on both the distance and elevation scales in the center of the figure. All that is necessary to remember is that every time you cross "zero," whether in distance or elevation, you shift the multiplication division lever.

KIRK MILES
Guntersville Dam, Ala., Nov. 5, 1938

ENGINEERING NEWS-RECORD

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Editorial Offices at 330 West 42nd Street, New York

DECEMBER 1, 1938

THE MOVE made by the Associated General Contractors at their recent fall board meeting to take an aggressive, rather than a negative, attitude toward national legislation is a commendable one. For many years the A.G.C. has been active in legislative affairs, but has used its energy and influence largely in efforts to defeat or modify pending legislation harmful to construction and contracting, or to support desirable measures initiated by others. Under a mandate from the recent meeting, the A.G.C. legislative committee is now empowered to draw up a legislation program covering problems that are of national importance and yet concern construction. Thus, not only will the wishes of organized general contracting be known in advance to both old and new members of Congress, but many sound constructive measures will be submitted for Congressional consideration. Heretofore the contractors have always had to make goal-line stands for their very life against legislation proposed by labor, relief agencies, selfish political groups and others. Now they have a chance to do some ball carrying of their own.

New Tools Found

THE REVIVAL OF BRICK PAVEMENT with grout-filled joints described on a following page encourages the hope of obtaining the structural advantages of this rigid design without its manifest disadvantages of operation. Credit for the new possibility is shared between office design and more exact field construction. Vast improvement has been made in both in the last decade and a half since paving engineers turned away from the so-called monolithic construction to a flexible construction better able to keep its shape with changes of temperature. In design the new brick road developed by the Ohio highway department is most remarkable in its provision for temperature movements. For the brick surfacing these provisions are unique. In the field work accuracy of construction is equally evident. Nowhere before in brick paving has the precision of machine work been sought for so exactingly by the constructor. This refinement was carried beyond the templet accuracy of vibrating instead of rolling the brick to include machine produced accuracy of line and surface in subgrade, concrete base and joint formation. The Ohio engineers and contractor have done more than compact a brick surface in an unusual way, they have shown how the advance in design and construction skill is eliminating old restrictions on the roadbuilder and giving him greater power to fit the materials of construction to his purposes.

A Further Excursion

FURTHER EVIDENCE of how the resourcefulness of construction men constantly is penetrating farther into the equipment field for machinery that offers special service is found in this issue in the description of methods for processsing an unfit local material into suitable concrete aggregate for Marshall Ford Dam. There the contractor broke boldly away from the usual gravel-pit-processing methods to those of the mining engineer and installed water classifiers and rod mills used almost exclusively in processing ores. A new type of equipment is added to construction field; the important lesson is however that modern construction calls upon the constructor to be equipment conscious to a greater degree than ever before. His information must reach beyond his familiar tools to those used in marginal fields of engineering.

Realism in Housing

SEVERAL THOUGHT-PROVOKING ideas on large scale housing were advanced last week by Park Commissioner Robert Moses of New York City in an address in which he suggested a three-year program for the city involving a dozen or more projects, those of public slum clearance nature to be financed with $200,000,000 of state funds under the constitutional amendment adopted in the recent elections and those of a private nature to be financed with $45,000,000 of insurance company funds. Mr. Moses would add to public housing planning and costs the planning and costs of the necessary sewers, schools, streets, fire protection and parks; he would acquire land by open condemnation instead of by secret assembly and purchase; and, according to the figures he presented, every housing site would include at least 20 acres, with some running as high as 80 acres. He calls acceptance of these fundamentals "realism in housing". Without doubt a careful and fair consideration of them must be made in any realistic approach to public housing. Planning of all necessary public utilities at the time the housing is planned is patently sensible; to charge the cost to the housing is more open to challenge, yet this housing is to be tax exempt and therefore will not return any of the charges as will a private development. Acquisition of land by open condemnation is

universal for all other public work, why not for housing? The third point, use of large sites, would seem to be least subject to question, for unless a housing development is large enough to dominate a neighborhood, it can but revert to the slum status of the housing that it replaces. Wherever public housing is being considered, these proposals deserve consideration. To that extent at least they represent realism in housing.

Buildings Can Resist Hurricanes

INDUSTRIES IN NEW ENGLAND suffered much unnecessary loss in the recent hurricane. This positive statement rests on the fact that the major cause of damage was lack of roof anchorage on factory buildings, a lack which has characterized damaged buildings in every windstorm in recent memory. No item in the report of the Factory Mutual Fire Insurance Companies on damage suffered by industrial plants insured under their policies is emphasized as much as inadequate roof anchorage. "Securely anchored roofs survived while unanchored or improperly anchored roofs were torn away." And the remedy is so simple, so inexpensive and so obvious that engineers should put roof anchorage at the top of their list of "must" items on every building. As the Factory Mutual report states, since windstorms create an uplift equal to the difference in air pressure inside the building and above the roof, anchorage of roof not only to walls but to interior columns should be mandatory. And since this uplift force is increased if the roof has an overhanging cornice under which the wind can apply a prying action or if broken windows permit the wind to enter the top story, cornice and window design should also engage the engineer's attention. Since a few simple expedients will make buildings more resistant to windstorms, every effort should be made to acquaint building owners with the facts.

The Public Pays

AN INDUSTRIAL ORGANIZATION that would abruptly discharge all department heads of its technical working staff and replace them by new men would be disorganizing its essential service so flagrantly and inexcusably that it would undoubtedly be brought up to a round turn by its directors and stockholders. The same situation is presented by the wholesale firing of Ohio highway department heads, reported last week. Reasons given are flimsy and untenable; if there are no others the public loses the needed services of an experienced, valuable organization. On the other hand, if a substantial cause existed for blanket "liquidation" of the staff, the state officials who permitted bad conditions to develop are grossly at fault. To take another lesson from private industry: the new management (which in this case has already been assured by recent action of the voters in electing a new governor) can best show the way toward good public service by refusing to recognize any other consideration than efficiency in the state highway organization. The organization should be no part of a patronage system.

The Dayton Explosion

REASONABLY CONCLUSIVE EVIDENCE places responsibility for the Dayton sewage plant explosion of Nov. 12 on gas escaping through U-traps installed in gas lines to eliminate difficulties which developed in operating the plant. The designers of the plant recognized the danger inherent in the collection and piping of gas to compressors and installed water sealed flame traps in the gas lines within the gallery. But slurry in the gas mains fouled these traps and made frequent cleaning necessary. To get rid of the slurry the plant operators put in water-sealed traps through which it could be run off to a drain in the gallery without loss of gas. The operators believed these traps to be safe against leakage of gas, but under abnormal pressure conditions which developed occasionally in the gas mains it was found that the seals in these traps had blown. Such blowing on the morning of Nov. 12 is believed to have filled the gallery with an explosive mixture of gas which was set off by sparks from a small motor used for experimental work at one end of the gallery. The destructive explosion which followed serves to emphasize how necessary it is for both designers and operators to set up all possible safeguards against leakage from the gas collecting systems of sewage disposal plants and to see that the safeguards continue to function properly.

Comment on the Dayton sewage plant explosion would not be complete without acknowledgement of the spirit in which the staff of the Department of Water and Sewers has cooperated in providing the engineering profession with full data on the accident and its probable cause in order that any lesson to be learned from the accident might be made as forceful as possible. At the request of the editors of this journal, M. W. Tatlock, superintendent of sewage treatment, prepared the telegraphed report published in our issue of Nov. 17. Subsquently, in sending us additional data, Mr. Tatlock said, "My final comment is *caution* and still more *caution* when handling sewer gases and if there is anything that has been overlooked in the consideration of this explosion I hope someone will point it out to us." It is this spirit which turns accident into stepping stones by which the profession advances to safer construction.

PICTURES IN THE NEWS

DESTRUCTION IN DAYTON. *At 5:20 a.m. Nov. 12, ignition of sewage gas which had accumulated in a gallery between two batteries of Imhoff tanks, caused a blast that put the Dayton, Ohio, sewage disposal plant out of commission. The two views at the left show what happened to the enclosed gallery. The roof slab, a piece of which rears its jagged form in the photo above, was torn clear to expose the ripped piping that remained below. A report on the probable cause of this explosion is given in the News of the Week pages of this issue.*

ENR Staff Photos

The Low Dam at Marshall Ford

KENNETH B. KEENER
U. S. Bureau of Reclamation, Denver, Colo.

Third and largest dam for Colorado River flood control in Texas is so designed that 74 ft. can be added to its height at a later date to increase storage

MARSHALL FORD DAM, on the Colorado River, in Texas, one of the larger dams now under construction, is being built by the Bureau of Reclamation for the Lower Colorado Authority, which is itself engaged in other development work on the Colorado River. Marshall Ford is the third dam built by the authority, which was created in 1934.

To develop some of the large power resources of the river, private interests began early in 1931 the construction of the Hamilton dam, a long multiple arch dam located near Burnet, Tex., and about 100 miles upstream from Austin. Due to financial reverses, construction was discontinued in 1932 with the dam only about 25 per cent completed. Hamilton dam, the name of which was changed to Buchanan, was finished by the authority in July, 1937; and a concrete straight gravity dam, known as the Inks dam, located 4 miles downstream from the Buchanan dam, was constructed by the authority under a contract with the Morrison-Knudsen Co. of Boise, Idaho. This dam was completed in the fall of 1937.

The contract for the construction of Marshall Ford dam awarded late in 1936 to Brown & Root, Inc., of Austin, Tex., and the McKenzie Construction Co. of San Antonio, Tex., at a contract price of $5,781,235. The dam should be completed early in July, 1939.

The Marshall Ford dam site is northwest and about 20 miles upstream from Austin. The valley floor of the bedrock with a width of 1,100 ft. is comparatively flat, from which the abutments rise on about a 1 on 2 slope. Investigations at the site consisted of 14 core-drill holes, aggregating a total depth of 2,113 ft. The bedrock consists of relatively thin horizontal layers of limestone shale and marl. The overburden of silt and sand

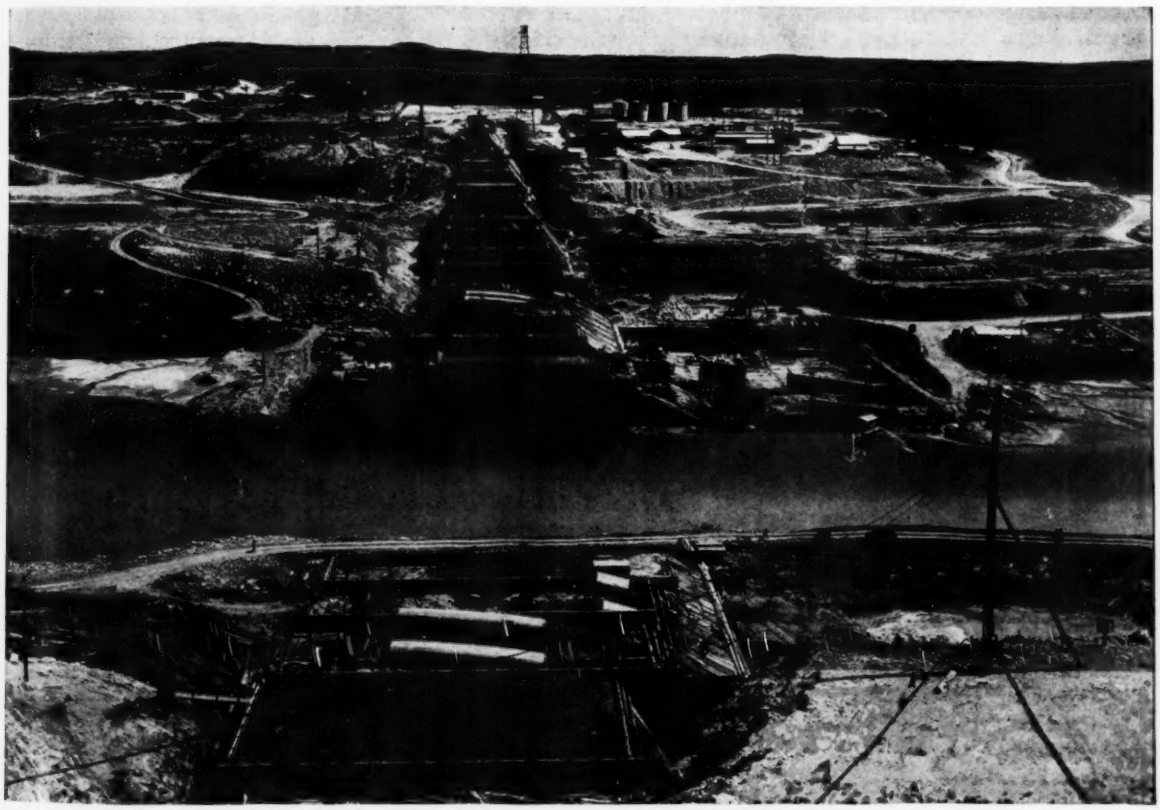

Fig. 1. The main part of Marshall Ford Dam is a concrete structure containing 24 large outlet conduits.

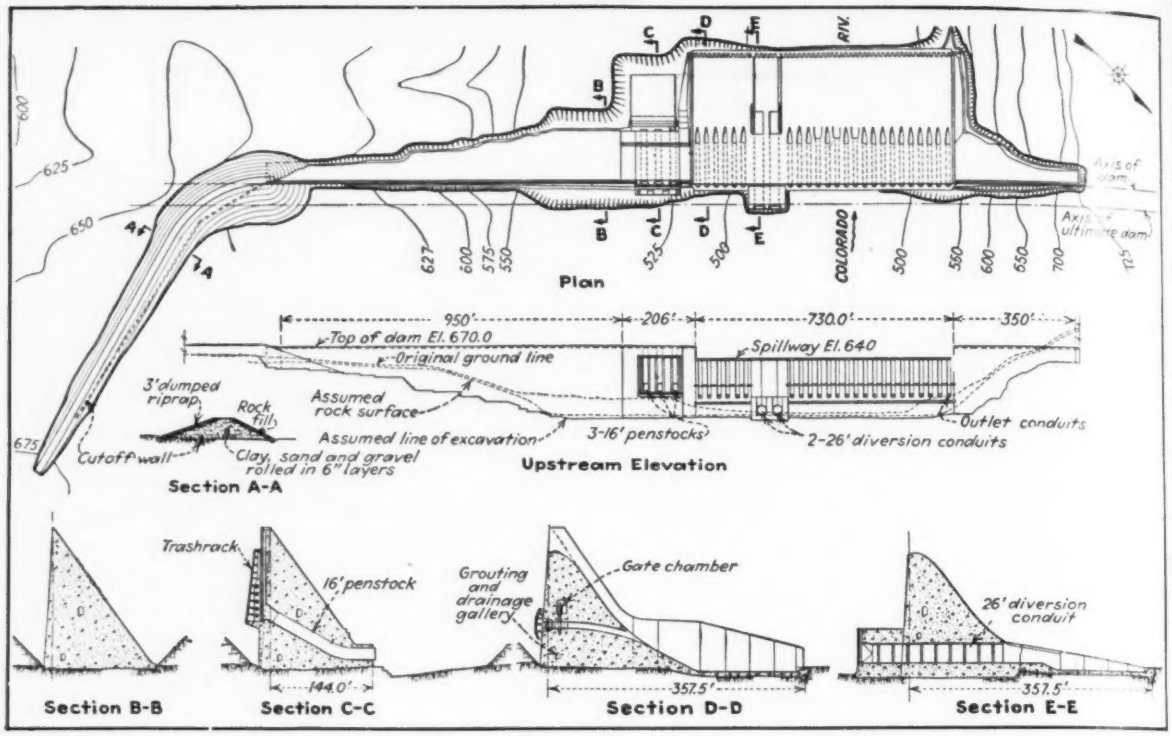

Fig. 2. Marshall Ford dam as planned for the first stage in construction; ultimately the dam will be made 74 ft. higher by adding to the upstream face; foundations (not shown) for this addition have recently been authorized by PWA.

reaches a maximum depth of about 50 ft. for a width of about 500 ft. at the left of the present river channel.

The dam now under construction will impound water 150 ft. above the present riverbed creating a reservoir of 573,000 acre-ft., which will extend 45 mi. upstream with a water-surface area of 11,000 acres. The ultimate dam will raise the water surface an additional 74 ft. providing a total storage capacity of 1,960,000 acre-ft. This reservoir will extend 50 mi. upstream with a surface area of 25,500 acres. The drainage area upstream from the damsite, ranging in elevations from 490 to 4,000 ft. above sea level, is 26,000 sq.mi., almost two-thirds of the drainage area of the entire river.

As shown by Fig. 2, Marshall Ford dam is of the concrete straight gravity overflow type, with a left abutment reach of earth and rockfill embankment. The total crest length is 3,340 ft., 1,050 of which is on embankment. The maximum height of the concrete dam from lowest point of foundation will be about 190 ft.

The upstream face of the dam is formed with horizontal keyways, 5 ft. from trough to trough, and shaped so that the faces are about normal to the direction of the principal stresses. This forming of the upstream face and the extraordinarily narrow crest of the abutment portions of the dam constitute provisions for the future high dam, which it is proposed will be constructed by extending the present dam upstream, the downstream face and other downstream features requiring no alteration. The present upstream face will then form a longitudinal contraction joint in the high dam. Vertical transverse construction joints are spaced about 50 ft.; embedded metal-tubing and outlet-box systems are provided for filling the joints with cement grout after they have opened sufficiently.

Foundation tightening consists of drilling vertical holes on 20-ft. centers over the entire area of the excavated foundation. These holes, about 25 ft. deep, serve for the injection of cement grout under relatively low pressures before concrete placement. After this blanket grouting is completed a line of holes, on 5 to 10-ft. centers and 75 to 100 ft. deep, is drilled 13 ft. downstream from the axis. Through these holes grout is injected at higher pressures by pipe connections from a low gallery in the dam. This grouting is accomplished after concrete has been placed to a substantial height.

The foundation will be drained after grouting is completed by a row of 2½ in. diameter holes 10 ft. on centers, drilled from the downstream corner of the low gallery in the dam, thus being only a few feet downstream from the deep grout curtain. Internal drainage of the concrete near the upstream face of the dam is by 5-in. porous concrete drain pipe set vertically on 10-ft. centers, 5 ft. downstream from the axis of the dam. These outlet into the same gallery provided for foundation grouting and drainage.

The overflow section of the dam with an ogee uncontrolled crest is 730 ft. long and a concrete apron is extended at the toe of this section of the dam to a distance of 357.5 ft. downstream from the axis. High training walls will be constructed at each side and a dentated sill at the end of the apron will produce a hydraulic jump. With the reservoir water surface at the level of the top of the abutment sections, the discharge will be 460,000 sec.-ft.

Two 26-ft. diameter conduits through the spillway section of the dam at about river level extend 73 ft. through a block of concrete to the upstream face of the proposed future high dam. These conduits, used for

diversion of the river during construction of the high dam, will be closed temporarily by bulkhead gates. The capacity of these conduits under full reservoir head will be 80,000 sec.-ft. The permanent outlet conduits through the spillway section are 24 in number, with bell-mouthed inlets and have a diameter of 102 in.; the discharge will be controlled by gates. The capacity of these conduits at full reservoir head will be about 110,000 sec.-ft.

While a power house is not included under the present construction contract, three 16-ft. steel penstocks, on 42-ft. centers, are being embedded in the concrete of the river end of the left abutment and the excavation is being made for a future power house adjacent to and over the downstream toe of the dam.

Quantities and direction

The principal quantities of work involved in the present construction are about as follows: 550,000 cu.yd. of common excavation; 327,000 cu.yd. of rock excavation; 68,000 cu.yd. of earth embankment and backfill; 21,000 cu.yd. of rockfill and riprap; 63,000 lin.ft. of grout and drainage holes; 980,000 cu.yd. of concrete; and 15,500,000 lb. of various types of metal work of which 8,000,000 lb. are in gates and 5,300,000 lb. are in reinforcement bars in the concrete.

Construction of the Marshall Ford dam was delegated to the U. S. Bureau of Reclamation by Harold L. Ickes, Secretary of the Interior and Administrator of Public Works. John C. Page, Washington, D. C., is commissioner of the bureau, C. McDonough, Austin, Tex., is general manager of the Lower Colorado River Authority. All engineering and construction work of the bureau is supervised by R. F. Walter, chief engineer, and S. O. Harper, assistant chief engineer, located at Denver, Col. J. L. Savage is chief designing engineer and W. H. Nalder is assistant chief designing engineer. E. A. Moritz with offices at Austin, Tex., is construction engineer. The writer is in charge of the division of dams in the Denver office.

Ore Processed Gravel For Concrete

Contractors for the Marshall Ford dam put ore classifiers, scrubbers and rod mills onto an old gravel bar to produce five sizes of aggregate

THE MANY LARGE DAMS constructed in recent years have very nearly conventionalized the plant for mixing and placing concrete. One is certain to find on every large operation complete mechanization and a degree of automatic control that a decade ago would have seemed marvelous. So that when the editor visited the working forces at Marshall Ford dam described by Mr. Keener in the preceding article he expected to find and did find the modern type of plant just indicated. But he also found some things that are unusual, particularly in equipment for processing the several sizes of aggregate that are used. For this work the contractor introduces devices that are more familiar in mining operations than in dam-building.

Novel processing plant

The concrete specifications required the contractor to produce and to stock separately five sizes of aggregate: Sand, $\frac{1}{16}$ to $\frac{3}{4}$ in.; $1\frac{1}{2}$ to 3 in., and 3 to 5 in. The sources of raw material located by the engineers were gravel bars about $1\frac{1}{2}$ mi. upriver from the dam. Before particularizing the pit materials and operations, however, a clear picture of the plant coordination is important. Nearly all the plant is located as shown by the sketch map, Fig. 1, at the southeast end of the dam where the concrete structure as de-

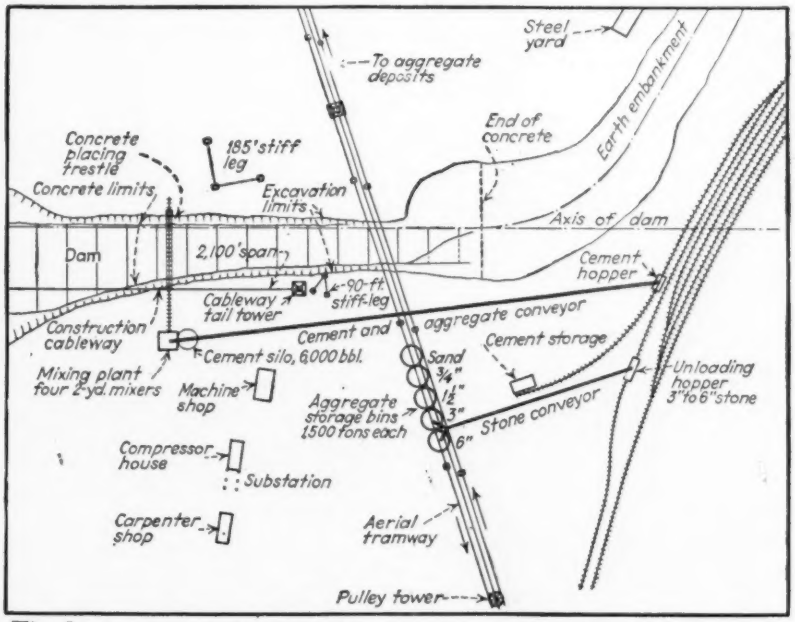

Fig. 1. Plant for mixing and placing concrete is concentrated at the southeast end of the dam; the cableway traveling head tower and one 185-ft. stiffleg are however across the river.

Fig. 2. Pitt washing screen scrubs dust and slime from coarse aggregate.

scribed by Mr. Keener merges into embankment. This is high on the bank (about El. 600) as shown by the valley profile in Mr. Keener's article, and the highwater advantage will be noted.

In the pit material the finer sand is largely silica; the gravel part has considerable limestone but of a quality considered suitable for concrete aggregate. The run of pit contains all sizes but there is a deficiency of the 1½ in. size and a surplus of large size sand. The lack of 1½-in. material is made up of crushed dolomite shipped in by railway. The gravel bar material is excavated by dragline and hauled by 6-ton trucks to a hopper from which a belt conveyor takes it to a raw material stock pile. Then the processing presents a picture of equipment with which the mining engineer is more familiar than is the contractor.

The unusual machines are Dorr classifiers and a rod mill, and a word of description is justified. In principle a Dorr classifier is a mechanism for separating particle sizes by flotation. The material is stirred by rakes in a current of water which takes up the lighter (finer) particles and floats them away. The rod mill is simply a pulverizing device; the coarse material is fed into a rotating cylinder in which are a number of loose, round steel rods about cylinder length; as the cylinder rotates the rods slide on the inside of the drum and on each other and grind down the coarse material.

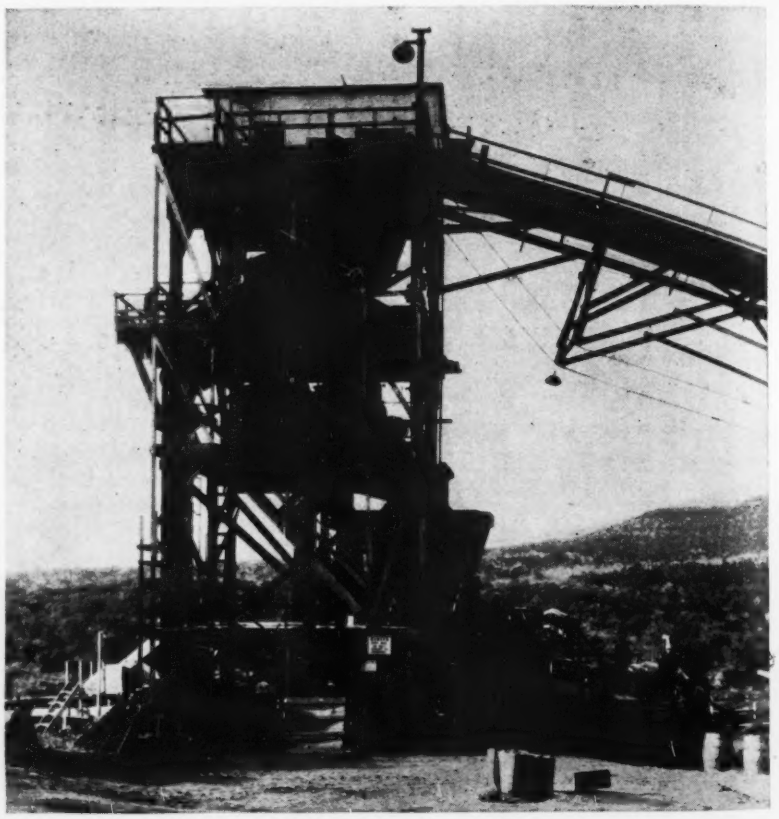

Fig. 3. Pit run gravel is screened into four sizes by vibrating screens; the sand size goes directly to the first classifier shown at the right of the screen tower.

Turning now to the aggregate processing at Marshall Ford, a 30-in. conveyor belt in a tunnel under the "raw" stock pile reclaims and elevates the material to the top of the processing

and classification plant shown by Fig. 3. Three heavy duty vibrating flat screens operated by electric motors grade the larger material into four sizes which are delivered to finger stackers making stock piles in a row over a tunnel containing a 30-in. recovery conveyor. Advantage was taken of a 50-ft. bluff on top of which the processing plant was placed with the stock piles at the foot. The fine and coarse sieve products now take separate courses.

The sand passing the screens drops to a cone hopper where it is partly dewatered and discharged into the classifier, Fig. 4, which separates at a 14-sieve size. The minus part goes to a second classifier which takes out the minus 100 to 200 part. The plus 14 material may be split three ways by a series of flap gates, to waste, to the sand stacker or to the rod mill. Usually some material is going all three ways but quantities vary as the pit varies. At times all the plus 14 can be used, but normally a great deal of it would go to waste, and did prior to the installation of the rod mill. The mill is 6 ft. in diameter and 14 ft. long. The rods of high carbon steel are $4\frac{1}{2}$ in. in diameter to start with but wear fast with the large percentage of silica sand with its high abrasive action; the metal loss is about $\frac{3}{4}$ lb. per ton of sand milled. The rod mill has proved to be a great saver of the preponderantly large percentage of plus 14 material in the bars. Its capacity is 35 tons per hour.

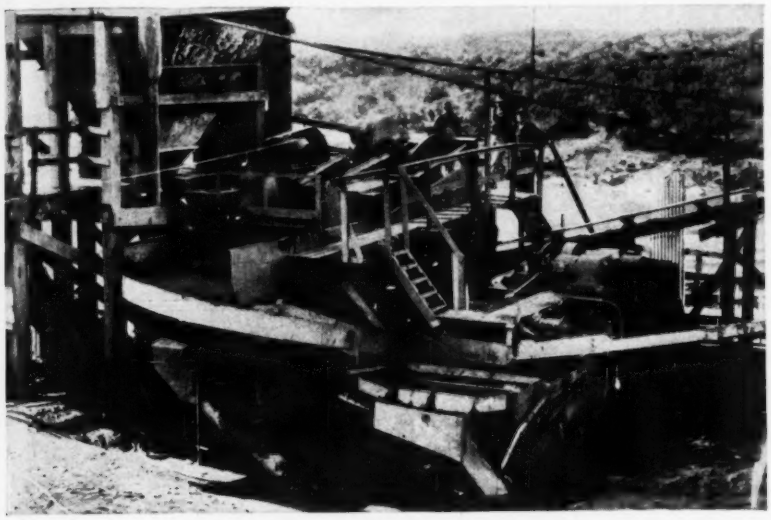

Fig. 4. A classifier, more commonly used in processing ores, which separates sand sizes by flotation; one classifier separates at 14-sieve size and the other removes minus 100-200 particles from minus 14 size.

The larger aggregates after recovery in the tunnel under the stock piles are passed to a rotating $\frac{1}{4}$-in. scrubber screen, 5 ft. in diameter and 14 ft. long (Fig. 2) to remove slime or lime dust. Some 600 gal. of water, about one-third of it under pressure, is applied in the scrubber.

Aerial tramway to dam

Carrying the prepared aggregate from the pit plant to the dam again rather smacks of mining practice. From the scrubber a 30-in. belt conveys the material to the loading sta-

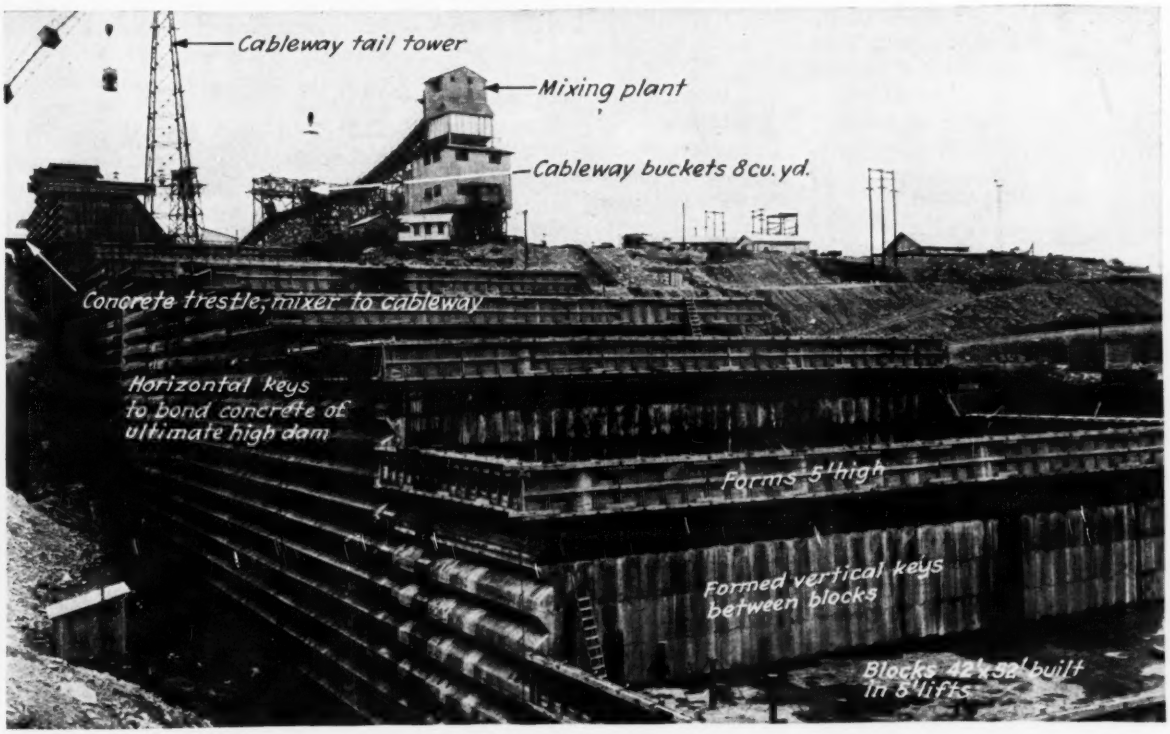
Cableway tail tower
Mixing plant
Cableway buckets 8 cu. yd.
Concrete trestle, mixer to cableway
Horizontal keys to bond concrete of ultimate high dam
Forms 5' high
Formed vertical keys between blocks
Blocks 42' x 90' built in 5' lifts

Fig. 5. Sequence of steps in placing concrete for the Marshall Ford dam.

tion of the aerial tramway. Bins for the respective sizes are provided around the circular track which carries the buckets by gravity after they have been detached from the ¾-in. endless traction cable and the 1¼-in. stationary return-carrier cable. As the buckets come around the loading terminal a stop on the gate of the bin from which material is to be dispatched is engaged to halt the bucket for loading. The bucket then proceeds by gravity to an automatic dispatcher which releases a bucket every 25⅔ sec. to give a 250-ft. spacing on the 1⅝-in. stationary load-carrying cable. A reserve of three or four buckets line up back of the dispatcher. Even spacing of buckets is essential to prevent lifting the cable from the saddles of the lower towers on the line. The grade of the gravity track around the loading bins is set to produce a speed equal to that of the traction cable at the point where the latter is engaged. This is so well worked out that one cannot discern any speedup at this point. Sidesway, due to heavy winds which at times sweep up the river, is a hazard which has derailed a few buckets.

The buckets carry first one kind of material then another to fill the five aggregate tanks at the discharge end. An unloader who sets the unloading trip, telephones the starter when the particular bin being filled is nearly full. The loader then phones back the number of the bucket which contains the new size. There are 84 buckets of 36-cu.ft. capacity each and the tramway, which is 8,500 ft. long and is operated by a 100-hp. motor at the loading end, delivers 250 tons per hour.

At the dam

At the dam the equipment is strictly modern but entirely conventional and is well enough indicated by Fig. 2. There are however one or two noticeable differences from ordinary in placing the concrete. As shown by Fig. 6, the keying is elaborate; transverse joints are keyed by vertical V-shaped grooves; similar horizontal grooves, 3⅓ ft. across, are placed in every 5-ft. lift on the upstream face with which to bond the concrete of the future high dam.

In the forms for the 5-ft. lifts, a simple method of ties is provided by sticking ½-in. rods vertically into the wet concrete about 6 ft. back from the face. When ready to set the next form, the rods are bent to the form and a "she" bolt is threaded onto the end and dropped into a slot in a casting fitting over the top wale. A 6-in. adjustment in length is provided. The bottom of the form is secured by larger 1-in. bolts threaded onto the previously used top rods. These ties are set about 4 ft. apart. The forms are lifted by home-made A-frames constructed of 2-in. pipe welded to a sheet metal gooseneck with two holes. The forward hole supports a jack, which is used to lift the form; a cable through the hole in the back part of the plate is anchored to a hair-pin in the concrete.

Construction of the Marshall Ford dam is being carried out by the U. S. Bureau of Reclamation. The general contractors are the McKenzie Construction Co., and Brown & Root, Inc., for whom Ross White is manager in charge. E. A. Moritz is construction engineer for the Bureau of Reclamation which maintains an office in Austin. Charles P. Seger is resident engineer at the dam. E. M. Whipple is superintendent and M. P. Anderson is engineer for the contractors.

Sewer Rental Practice

Experience of municipalities in applying and collecting service charges for sewage disposal

Growing interest in the sewer rental method of financing disposal works lends special timeliness to a survey of practice recently completed by the Portland Cement Association. The following is an extract of the findings which were published in the September issue of CONCRETE HIGHWAYS AND PUBLIC IMPROVEMENTS—EDITOR.

IN ADDITION to accepted administrative functions, local governments to an increasing extent are becoming responsible for specific services. Supplying a community with clean water and providing for disposal of its spent water and wastes are utility services. The need for new sources of revenues has brought about widespread acceptance of the principle of making a definite periodic charge for the service rendered.

This has, for some time, been generally used for water supply with rates based usually on consumption. The application of a similar charge for sewerage service is becoming widely recognized. The outgrowth of this is the revenue bond method of financing. This is a form of municipal bond issued by a political subdivision for the purpose of constructing, acquiring or improving revenue-producing works such as sewerage and water supply, when payment of such bonds depends entirely upon the revenue of the individual utility.

In financing sewerage works strictly on a revenue bond basis, some questions arise regarding the equity of the rates for sewer rental charges. Sometimes the direct benefit to property is neglected. It should be recognized that property is benefited regardless of whether or not the sewer is connected.

The logical solution is to provide a fair "ready-to-serve" or "availability" charge. This is sometimes taken care of by a special charge at the time property is connected to sewer. In other cases where storm water is carried in the system, a regular charge may be made against the owner of vacant property in proportion to area served.

Rate schedules

In some cases the sewer rental charge is based only on the cost of construction and operation of the treatment plant and the cost of the collection system financed from general taxation or special assessment. Greater attention, however, is being given to planning a rate schedule for sewer rental charges that will enable this one simpler method to cover the entire cost of the complete sewerage system. Close cooperation with the waterworks department will permit the billing to be done from one office.

With modern methods of accounting this will not entail much, if any, additional collection expense.

Many municipalities have worked out ingenious methods of billing to meet their particular requirements. The simple statement showing separately the amounts charged for water and for sewer service is the type most generally preferred. It is especially desirable that bills be rendered monthly or quarterly.

SEWER RENTAL EXPERIENCE

STATE & CITY	POPULATION	FINANCED WITH REVENUE BONDS	RATE BASIS: WATER CONSUMPTION	RATE BASIS: OTHER METHODS	BILLING METHODS: MONTHLY	BILLING METHODS: QUARTERLY
ARKANSAS						
Batesville	4,500	Yes		Flat rate	Yes	
Brinkley	3,046	Yes		Flat rate	Yes	
Fordyce		Yes		Flat rate	Yes	
Little Rock	80,000	Yes	Yes		Yes	
Stuttgart		Yes		No. of connections		
Waldron		Yes		Varies with service		
West Memphis	2,900	Yes		No. of fixtures	Yes	
FLORIDA						
Ft. Lauderdale	40,000	Yes	Yes		Large meters	Small meters
Tallahassee	15,000	No		No. of fixtures	Yes	
GEORGIA						
Athens	22,000	No		No. of fixtures		
ILLINOIS						
Assn	4,000	Yes		No. of connections		Yes
Barrington	4,000	Yes	Yes			Yes
Belvidere	8,123	Yes	Yes			Yes
Edwardsville	6,500	Yes	Yes	Also flat rate	Yes	
Effingham	5,301	Yes		No. of connections		Yes
Elmhurst	15,000	Yes	Com'l.	Flat rate residences	Yes	
Kankakee	22,300	Yes		No. of fixtures	Yes (also bi-monthly)	
Lowanee	17,000	Yes	Yes			
Libertyville	4,000	Yes	Yes			Yes
Monmouth	9,000	Yes	Yes			
Rochelle	3,890	Yes	Yes		Yes	Yes
Sullivan	3,300	Yes	Yes			
Waterloo	2,300	Yes		Flat rate	Yes	
West Chicago	3,900	Yes	Water & sewer combined			Yes
West Dundee	1,900	Yes		Flat rate		Yes
INDIANA						
Bloomington	18,227	Yes	Yes (discharges into sewer)		Yes	
Goshen	12,000	Yes	Yes (plus flat rate & connect. chg.)		Yes	
Kokomo	22,843	Yes	Yes	Also flat rate		
La Porte	16,000	Yes	Yes	Flat rate	Large users	Small users
Michigan City	30,000	Yes	Yes	Flat rate	Yes	
Mitchell	3,220	Yes	Yes			
IOWA						
Cedar Rapids	60,000	Yes	Yes		Yes (also bi-monthly)	
Ft. Dodge	25,000	No	Yes			Yes
Iowa City	15,340	Yes	Yes		Yes	
Mt. Vernon	1,500	Yes	Yes			Yes
KENTUCKY						
Beaver Dam	1,050	No		No. of fixtures	Yes	
Providence	3,000	Yes	Yes		Yes	
Richmond	7,500	Partly	Yes	Also flat rate	Metered	Flat rate
LOUISIANA				Flat rate on		
Jennings	6,500	No		water bill	Yes	
MICHIGAN						
Ann Arbor	30,000	Yes	Yes		Partly	Yes
Battle Creek	45,000	Partly	Yes		Yes	
Grand Haven	8,345	Yes	Yes		Yes	
Jackson	55,000	Yes	Yes (based on winter months)		Yes	
Traverse City	13,000	No	Yes			Yes
NEBRASKA						
Adams	535	No		Flat rate	Yes	
Blue Hill	669	No		Flat rate	Yes	Yes
Columbus	8,000	Yes		Flat rate		
Lawrence	528	No		Flat rate	Yes	
Peru	835	Yes		Flat rate	Yes	
Trenton	965	Yes		Flat rate	Yes	
NEW YORK				Balance charged		
Buffalo	583,000	Yes	Yes (55%)	against real property	Monthly, quarterly & semi-	
Plattsburg	13,347	Yes		Flat rate and no. of connections		annually
OHIO						
Bedford	7,400	No	Yes			Yes
Berea	6,000	No	Yes			Yes
Bowling Green	6,700	No		Flat rate		Yes
Dayton	220,000	Yes	Yes (Modified)			Yes
Findley	20,000	Partly	Yes		Yes	
Greenville	7,038	Partly	Yes			Yes
Mansfield	35,000	No	Yes			Semi-annually
Oxford	2,570	Yes	Yes			Yes
Springfield	70,000	No	Yes			Semi-annually
Toledo	300,000	No	Yes			Yes
PENNSYLVANIA						
Abington Township	18,500			No. of fixtures		
Cheltenham Township	18,200	No		No. of fixtures		
Haverford Township	25,000	No		No. of fixtures		Annually
Jenkintown	5,000					Annually
Media	5,000	No	Yes	Also no. of connect'ns		Annually
Radnor Township	12,317			No. of fixtures		Annually
Springfield Township	5,000			No. of fixtures		Annually
U. Moreland Township	4,500	Partly				Annually
TENNESSEE						
Lawrenceburg	3,500	Yes		Flat rate	Yes	
Parsons	1,000	Yes		Flat rate	Yes	
TEXAS						
Alvin		No		Flat rate	Yes	
Big Spring	15,500	No		Flat rate	Yes	
Brownsville	25,000	No		No. of connections	Yes	
Corpus Christi	56,000	Yes	Yes (with		Yes	
El Paso	102,000	Yes	min. charge)	Flat rate		
Jasper	4,500	No		Flat rate	Yes	
La Feria	1,600	No		No. of connections	Yes	
Lufkin	10,000	No		No. of fixtures		Yes
Mineral Wells	7,000	No		No. of fixtures	Yes	
Raymondville	3,800	No		Flat rate & fixtures	Yes	
Snyder	4,000	No		Connections & fixt.	Yes	
Sweetwater	15,000			Fixtures	Yes	
Wharton	3,600		Yes	Minimum & fixtures	Yes	
VIRGINIA						
Berryville	1,200	Yes		Flat rate		Semi-annually
Christiansburg	2,000	No		Flat rate	Yes	
Herndon	1,000	Partly		Flat rate		Yes
Roanoke San. Dist.	6,000	Yes		Flat rate		Yes
Williamsburg	3,778	No		Flat rate		Yes
Winchester	12,500	No		Flat rate		Annually
WISCONSIN						
Oshkosh	40,108	Mostly	Yes	Flat rate		Yes

The accompanying table indicates the favorable collection experience of municipalities. It has been found that delinquencies in sewer rental accounts are exceedingly small and generally no greater than for water accounts. Because of unfamiliarity with this relatively new method of sewer service charge a few protests have been registered when the bills were first rendered. When the facts are properly presented the complaints quickly disappear. With more general application of the sewer rental method, protests will be few.

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Bridge Bearing Rollers

THREE DIMENSIONAL aspects of the design of rollers for bridge bearings are discussed by V. P. Jensen in *Bulletin 138* of the Iowa Engineering Experiment Station. Mr. Jensen refers to the fact that in 1935, the American Railway Engineering Association published new specifications for the bearing capacities of rollers, and states that these were revised later, largely as a result of extensive tests made at the Engineering Experiment Station of the University of Illinois. "While the tests revealed hitherto unknown characteristics of rollers, analysis has neither verified nor disproved these characteristics." But until recent years the theory of bearing capacity of a roller as a linear function of its diameter has been widely accepted.

The author proceeds to consider the finite length of roller by deriving critical loads for two extreme types of rollers and providing a smooth transition curve between these extremes to give the critical loads for intermediate rollers. The expression so obtained is offered as an indication of the theoretical maximum load that a roller of finite length may carry without damage to itself or the bearing plate. From numerous tests, made with many different methods of testing, the author finds certain trends which, so far as known, have not yet been explained adequately by theory, as follows:

1. The bearing capacity of a roller varies approximately as the square of the yield point of the material.

2. The diameter has a non-linear effect on the bearing capacity.

3. Within certain limits the critical load per unit length is affected by the length of the roller.

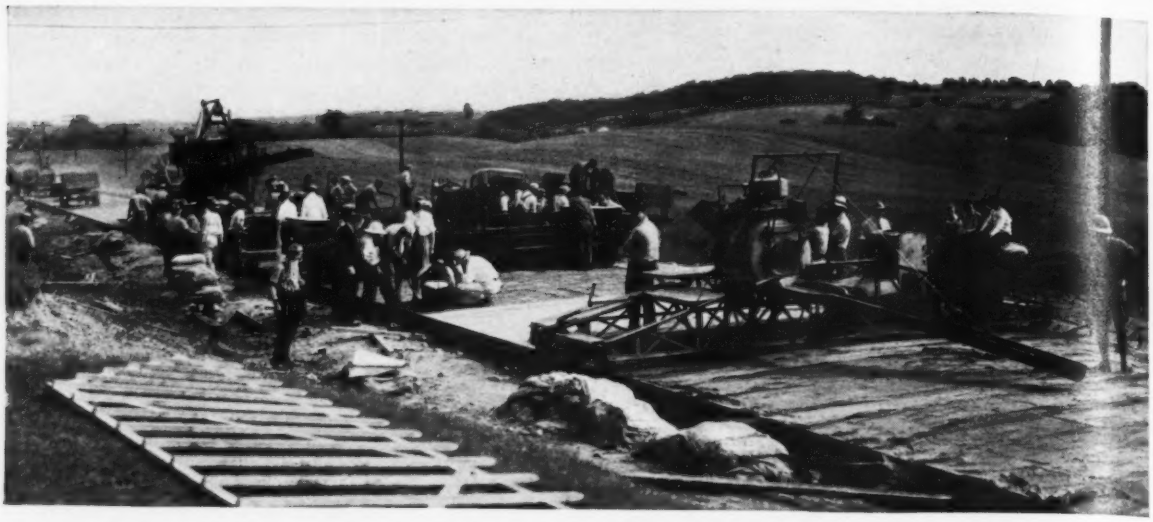

FIG. 1. IMPRESSIVE TRAIN OF EQUIPMENT IS EMPLOYED ON A MODERNIZED MONOLITHIC BRICK ROAD

A Monolithic Brick Pavement Revival

V. K. GAMBLE

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By highly mechanized base construction and by vibrating the brick into the green base concrete, Ohio road engineers seek remedy of former defects in monolithic brick-pavement construction procedure

THE RECENT CONSTRUCTION in Ohio of 2.2 miles of monolithic brick pavement using methods and machines heretofore untried is an interesting development of the present roadbuilding season. For almost fifteen years brick surfacing bonded into fresh base concrete and having rigid cement-grouted joints has not been included in highway programs. It had proved too difficult to secure a good riding surface and to prevent temperature blowups. Yet numbers of these roads that had been built proved sound and the type did offer evident structural advantages. If their smoothness could be insured and temperature disturbances controlled, monolithic brick obviously had a definite claim for renewed road use.

Control, it was believed, was guaranteed by the greatly improved design technique and an increased perfection of machine construction developed during a decade and a half. A design was adopted that provided for a full complement of longitudinal and transverse joints and a full use of machine construction for precision of surface. A notable equipment requirement was that in place of rolling, the brick should be vibrated to bond and smoothness by a machine consisting of a series of vibrating longitudinal straight edges not less than 6 ft. long and traveling along the pavement. Specifically the joint construction was to be a center longitudinal joint, through the brick surface and 2½ in. into the concrete base, of ½-in. premolded bituminous material, and transverse expansion joints every 60 ft.

Precision built base

Insurance of surface smoothness, however, was not rested on one construction device; it began at the subgrade and was carried up through every construction detail of the concrete base. This base was a 9:7:9 in. section of 1:7½ concrete reinforced with wire mesh 3 in. below the top. Both subgrade and base were built with a 2-in. crown. To give this crown to the subgrade a subgrade finisher was used. Foundations for the side forms were trenched by machine; the forms were 9 in. high, that is, they were set for the concrete base alone, a fact that is to be recalled later. As the paving mixer worked back along the subgrade it was followed by a subgrade planer and a steel-pin scratch templet to secure final accuracy of subgrade.

Base construction was entirely a machine operation. A 27-E paving mixer, taking truck-delivered batches from a commercial proportioning plant, mixed 1 to 1½-in. slump concrete. This was placed by a vibratory finishing machine, which first struck off the slab 3 in. low for placing the reinforcement and then finished it to surface profile.

As indicated previously, the longitudinal premolded joint filler was sunk 2½ in. into the concrete base and extended up 3 in. through the brick

surface. To hold the unsupported filler until the brick were laid, steel caps were used. The transverse joint filler reached through both base and brick surface and was 1 in. thick. This filler was premolded bituminous material topped with 3½ in. of premolded cork. The longitudinal center joint and premolded cork portion at the transverse joints were installed by a joint machine which also carried a screed for the final finish of the base. The bituminous premolded expansion joint material was assembled in a wire cage which also supported the dowel bars and was set in position on the subgrade between the mixer and the point of depositing the concrete.

Vibrated brick surface

The distinctive feature of the brick surfacing was, as previously indicated, the use of a vibrating machine to bond the brick into the green base concrete and to true the surface. This machine was designed and built especially for work by the Flexible Road Joint Machine Co., Warren, Ohio, and Fig. 2 shows it in operation. It consists essentially of a mobile frame carrying a series of longitudinal straight-edge members that are given 3,600 pulsations a minute by four electrically-driven vibrators. The machine weighs 14,800 lbs. and is self-propelling both ways; in Fig. 2 it is pictured reversed so that the vibrated brick surface may be seen more clearly.

Turning again to the construction procedure: After the completion of the base course a 3½-in. steel extension form was clamped and braced on top of the 9-in. side forms to carry the roller carrier, the brick vibrator and the grout mixer.

The interval between pouring the concrete and dropping the brick varied from 1½ to 3 hr. depending principally on the air temperature and relative humidity. The droppers received brick from a roller carrier fed directly from brick trucks on the berm. This eliminated hacking the brick and kept spalling and subsequent necessary culling at a minimum.

At transverse expansion joints the first course of brick on each side was laid with the longest dimension of the brick parallel to the center line. Throughout the balance of the pavement laying started at the right hand side and progressed to the center where closures were made by batting with not less than one-third of a brick. Laying then continued from the other side of the center joint and progressed to the left hand side with closures made in the same manner.

The metal plates used to hold the ribbon center joint material in vertical alignment during laying were pulled out just prior to operating the vibrator. The vibrating followed fairly close to the dropping depending slightly on the rate at which the concrete was setting up under the brick and generally one pass with the vibrator was sufficient to remove surface irregularities and imbedded the brick firmly in the plastic concrete. What culling was necessary was usually completed ahead of the vibrator but it was found that this could also be readily carried on after the vibrating was completed.

The settlement of the brick into the concrete as a result of the vibration was from $\frac{1}{16}$ to $\frac{1}{8}$ in. with an occasional measurement of $\frac{1}{4}$ in. being recorded. This resulted in from $\frac{1}{4}$ to $\frac{3}{4}$ in. of mortar being forced up into the joints between the brick from the bottom.

A grouting machine built by the contractor and consisting of a one-

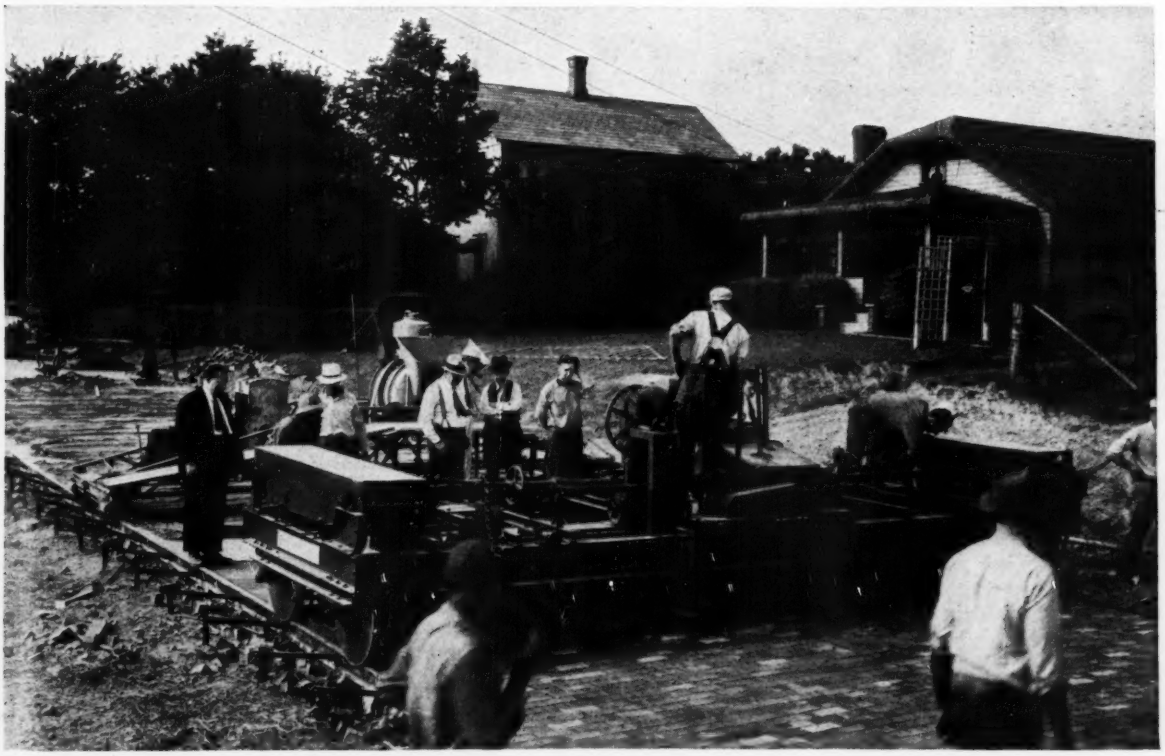

Fig. 2. A new machine takes the place of the roller and vibrates the brick surface with templet accuracy into the fresh concrete base of a new Ohio road

bag mixer mounted on an old finishing machine carrier with suitable wooden runways to the charging hopper was used to mix and distribute the cement grout filler. This machine was equipped with a movable chute so arranged below the mixer that grout could be deposited anywhere within a 10-ft. radius of the discharge gate. Sacked sand and cement were used to charge the mixer, the proportions being 1:2 by volume. After the first application of the grout, it was squeegeed over the surface into the brick joints and allowed to settle. After all visible settlement had ceased a second application of slightly thicker grout was made. The final surface finish of the pavement was accomplished by dragging wet burlap straight ahead over the completed grouted brick surface.

The entire pavement slab was cured for 24 hr. with wet burlap and subsequently with 3 in. of wet straw until beams made of concrete identical with that in the base and cured in the same manner had shown that the required flexural strength had been obtained. The side forms were left in place for 12 hr. and when removed earth was immediately banked against the edges of the vibrated pavement.

On the construction of this pavement it was possible to complete slightly more than 600 lin.ft. of 20-in. pavement in a working day in which no single operation, that is, concreting, brick laying or grouting, worked more than eight hours. The work was carried out in the field by W. L. Belknap, resident engineer, L. L. Luke, project engineer, and C. R. Hanes of the construction bureau of the Ohio department of highways, John Jaster, Jr., director. The contractor was the Elmer O. Vogt Construction Co., Massillon, Ohio.

Thirteen Armory Buildings

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Arch-bent framing, walls and partitions of concrete feature WPA-built structures in Illinois

In the statewide building program being carried out by the concrete armories and recreational buildings are being constructed in thirteen different towns by WPA labor. Based on typical designs worked out in the office of the supervising architect of the armory board, the buildings are interesting both architecturally and structurally. The towns involved are Carbondale, Champaign, Delavan, Dixon, Elgin, Lawrenceville, Mt. Vernon, Pontiac, Salem, Streator, Sycamore, Urbana and Waukegan.

Concrete decided upon

The original layout specified steel arch-bent framing, exterior walls of face brick with stone trim and hollow tile backing and interior walls and partitions of load-bearing tile. However, the high proportion of skilled labor needed for this type of construction was a disadvantage and a concrete design was substituted which utilizes concrete for all walls, partitions and framing, the latter, to conform in general appearance with the original design, being made of arch-bent type. Unlike the original design, the concrete construction requires a large amount of common labor for rough as well as for finishing work, and its adoption has proved well justified.

Armory sizes

The central feature of a typical one-company armory, measuring 131x194 ft., is the drill hall auditorium, measuring 90x120 ft., with a stage platform at one end. The drill hall is two stories high, flanked on all sides by one-story wings containing lobbies, offices, recreation rooms, supply and locker rooms and a garage. Boiler rooms, fuel storage and rifle range are accommodated in a basement.

A two-company armory in Waukegan is similar to the one-company armories used generally except for size, its plan dimensions being 135x 299 ft. and its drill hall 91x153 ft. A special two-company armory at Urbana has a large stable with stalls on the first floor and feed storeroom on the second, which floor also contains the officers club room and offices. This building measures 149x263 ft. and the drill hall is 91x204 ft.

The concrete arch bents of 90 ft. span (in all sizes of armories) are designed as two-hinged, and their legs are connected by tension rods under the floor of the drill hall. The bents are built with monolithic brackets which support concrete purlins, and these in turn carry wood sheathing and composition roofing.

Special conditions required careful study of construction joint location both in the walls and the bents. The first joint in the arch bent legs was placed at the level of the roof of the adjacent one-story wings, since

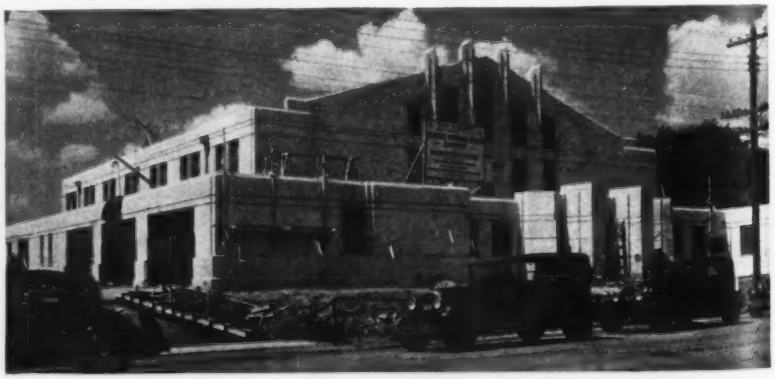

Fig. 1. Typical of thirteen new National Guard armories in Illinois is this architectural concrete structure in the town of Sycamore

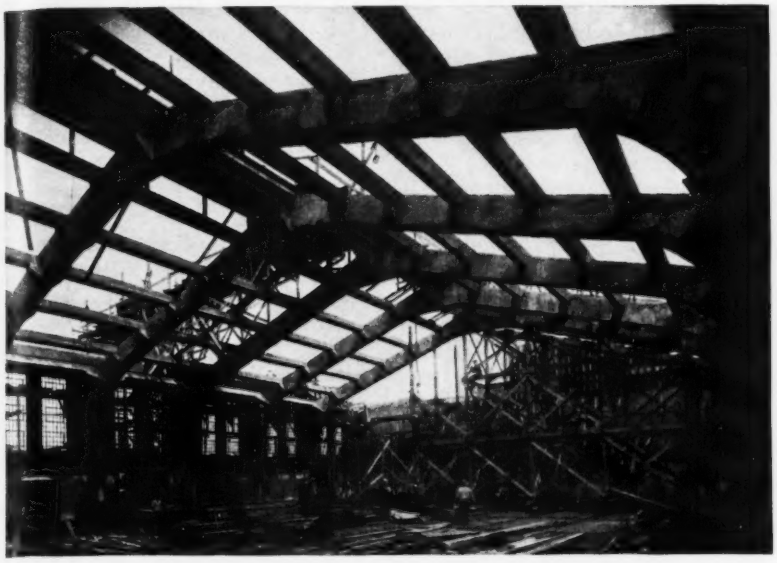

Fig. 2. **Reinforced concrete framing is a feature of the new Illinois armories. Note how purlins rest on brackets monolithic with bents. Each second purlin is reinforced as a strut.**

it was stipulated that the arch legs should be poured independent of the continuous concrete wall below this level. The legs are separated from this wall by paper joints and project 1 in. beyond the wall line in order to conceal this wall construction joint.

Above the first construction joint at the low roof level, the legs are poured monolithically with the wall up to the top of the window sash where a second construction joint is used. This procedure was necessary because the architectural design on the outside of the wall made vertical wall construction joints undesirable. In order to carry out this scheme successfully it was important to ascertain that no undue lateral deflection would take place at the haunches when the arches were under full load; also to allow for sufficient sliding motion at the low roof level to eliminate pressure at the joints of contact with the arch columns. A third construction joint is located in the inclined rafter of each bent, halfway between haunch and apex. This system of construction joints also enabled the work to be carried on in units and had the additional advantage of eliminating high pressures on the forms by reducing the size of the pours.

Erection equipment

For each armory the principal piece of erection equipment was a timber traveler carrying a complete form system for two adjacent arches with their connecting purlins. The traveler also included a concrete hoist tower. When concreting of one unit was complete and the concrete set, the entire unit was moved ahead two panels and the operation repeated; the purlins in the intermediate or connecting panels were poured later. A 3,000 lb. per sq.in. concrete (at 28 days) was specified for all exterior work. However, to expedite pouring of the arches, high-early-strength cement concrete (3000 lb. in 3 days) was specified for the inclined rafters and purlins.

Personnel

The project is being carried out by the Illinois Armory Board with S. Milton Eichberg as supervising architect and Lieut. Joseph A. Crum, as technical supervisor. The WPA organization constructing the armories is under the supervision of A. M. Crain, director of operations. The writer was consulting engineer on the structural design of the thirteen armories.

How to Build Leaky Brick Walls With Good Materials

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No attempt will be made here to describe how to produce good brick walls. The problem after all is reasonably simple, and therefore capable of solution. However, judging from examples on every hand, much effort has gone into the production of leaky walls, even though carefully specified and selected materials were used. Up to the present time, in so far as the writer knows, there has been no concerted effort to educate the public to understand exactly how poor walls may be produced at will. There are a number of steps in the process; for some the owner and designer are responsible, and for some the builder may take all credit.

Without attempting to place the responsibility for any of the steps individually on either of the several participants, let us consider what these steps are.

First, there is compatability of materials. Just as incompatability in marriage leads to divorce, so in building materials it leads to separation. Each material used has characteristics peculiarly its own. For instance, the coefficient of expansion of brick masonry is approximately 0.0000031; that of limestone 0.0000044; and that of concrete 0.0000067. This simply means that in a length of 100 ft. with a temperature change of 100 deg., neglecting the effect of moisture, brick masonry if unrestrained would expand or contract $\frac{3}{8}$ in.; limestone 9/16 in.; and concrete 13/16 in.

Plain arithmetic

It is evident then that if an artificial stone (concrete) coping is placed on top of a brick wall and the end joints between adjacent stones are filled with a hard mortar, the stone in its endeavor to move twice as far as the supporting brickwork, in response to temperature

changes, must either be restrained and prevented from moving by the brickwork or else will crack the brickwork or slide on the brickwork; in either case openings will be made through which water can enter the wall. Obviously, if limestone were used for the coping, the movement would be much less, and the marriage might prove successful.

Having thus insured the formation of fissures, the next step is to try to prevent the water going any further. This can be done with flashings. Naturally, if the flashing is laid on a smooth bed of dry mortar with elastic cement at the outer edge; if the outside edge of the flashing is turned down ½ or ¾ in. to form a drip; if the edge on the inside is turned down two courses for a cap flashing, or up if required as a cutoff elsewhere in the wall; if the joints in the copper are made by first tinning the edges of the sheets, then locking them together and soldering the seams so that the joints are thoroughly filled and covered with solder; if all these things are done penetration of water will be stopped at this point.

But as this is not what we want to accomplish, let us lay our flashing on the top of the rough brickwork, keeping the edge ½ in. or more back from the surface of the wall so that it will not mar the appearance of the outside face. Next, let us simply lap or, at most, form lock seams without tinning and soldering the copper sheets when they lap. This will insure that any water which penetrates to the copper can readily go through the several joints or, if by any chance they happen to resist the flow of water, it can find its way to the outer edge of the flashing and thence down into the irregularities in the masonry below.

Another excellent way to assure a leaky wall is never to seal the copper flashings around and against the wall columns. This is particularly effective in the case of steel columns where the space between the flanges is usually filled very roughly with brick bats, mortar, and empty pockets so as to form a natural channel for the passage of moisture.

In laying up the brickwork, after the mason gets his line stretched and mortar bed laid, simply butter the outer edge of the brick to be placed and tap it into place. This will appear to give a full joint on the outside and if the owner happens to notice that it is not full all of the way back just tell him that this is common practice and that when the next bed of mortar is laid it will be squeezed down and fill the joint. Never admit to him or anyone else that the pocketed air will prevent this filling, because if all joints were thoroughly filled it might hinder getting what we are striving for—a poor wall with good materials. To insure further that the wall will be poor, lay up several courses of brick without changing the line or plumbing the face, then rack the wall until it is plumb and true. Doing this will guarantee that joints will be opened; also it saves money in laying.

There are still a few more precautions that should not be forgotten. Don't parge the back of the face brick; this might act as a barrier and stop some leaks. In laying the back-up bricks simply slap them into place on the mortar bed when no one is watching, without buttering the ends or sides, and cover the top face with more mortar as fast as possible so that the inspector can't see that the joints are not filled. Naturally, a little mortar must be used at vertical joints on the inside face of the wall because if these were left entirely open someone might notice it.

These notes could be further amplified to cover the use of membrane flashings, how to treat windows, doors, etc., but sufficient hints have been given so that any careless or unscrupulous builder who follows them can be sure to produce a poor wall with high maintenance cost at will, however excellent the materials used may be.

Water Softening Proposed at St. Paul, Minn.

CONVERSION of part of the St. Paul filter plant into a water softening unit has been kept in mind in planning the $600,000 filter plant extension put under contract last year, as noted in the annual report of the Board of Water Commissioners. This extension includes six new filter units, with increase in flocculator and clarifier basin capacity. With softening treatment, the hard water of the Mississippi River would be of better quality and color. While the cost of operation would be increased by $6 or $7 per million gallons it would result in much greater saving to the consumers. Further expense will be needed for land and equipment for the softening plant, but the present investment represents a large part of the cost.

Only 2.64 miles of 4- to 12-in. pipe and only 628 new services were put in during 1937. Contracts were let for three steel pipe lines and two electric centrifugal pumps to improve conditions in the high pressure district. These pipe lines are of 20-, 24- and 30-in. diameter, and it is stated that the bids for cast-iron and steel showed a saving of $50,000 for the latter.

The water at St. Paul is treated by coagulation, sedimentation, filtration and chlorination. Cost of chemicals is mainly for the aluminum sulphate used as a coagulant. In 1926, this cost was $4.44 per million gallons, but a change in the baffles of the mixing chamber reduced this to $2.84. In 1930 it dropped to $1.74, but since then the average has been $2.17. This gradual increase in cost may be due to the raw water requiring more coagulant for decolorization and clarification, or to the consumer demand for a higher quality of water. In passing through the lake system, the water undergoes a marked loss of suspended matter, resulting in the lowering of turbidity and color. Total consumption for 1937 was 8,997,000,000 gal., or a daily average of 24,650,000, considerably less than for 1936, but the maximum day's consumption was 52,100,000, or a 24 per cent overload at the filter plant.

The cost of filter operation averaged $6.995 per million gal. With 613.47 miles of mains, the cost of all repair and maintenance, including hydrants and street work, was $64.51 per mile, while maintenance cost was $33.78 per mile of main and $3.63 per hydrant. The pressure ranges from 30 to 120 lb., and there were 63 leaks in mains during the year.

Water Towers in the Netherlands

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IN A FLAT COUNTRY like Holland there are few opportunities for constructing ground reservoirs on elevated spots and only in the more hilly eastern and southern parts of the Netherlands can advantage be taken of natural heights. So, most of the supplies resort to the construction of elevated tanks of which there are now about 200, some 100 of which were built in the past 15 years. Half of the total number of 200 are for district supplies—which serve large and populous rural areas; most of these tanks may be called modern, while those for the urban centers generally represent the constructional and architectural principles of earlier years.

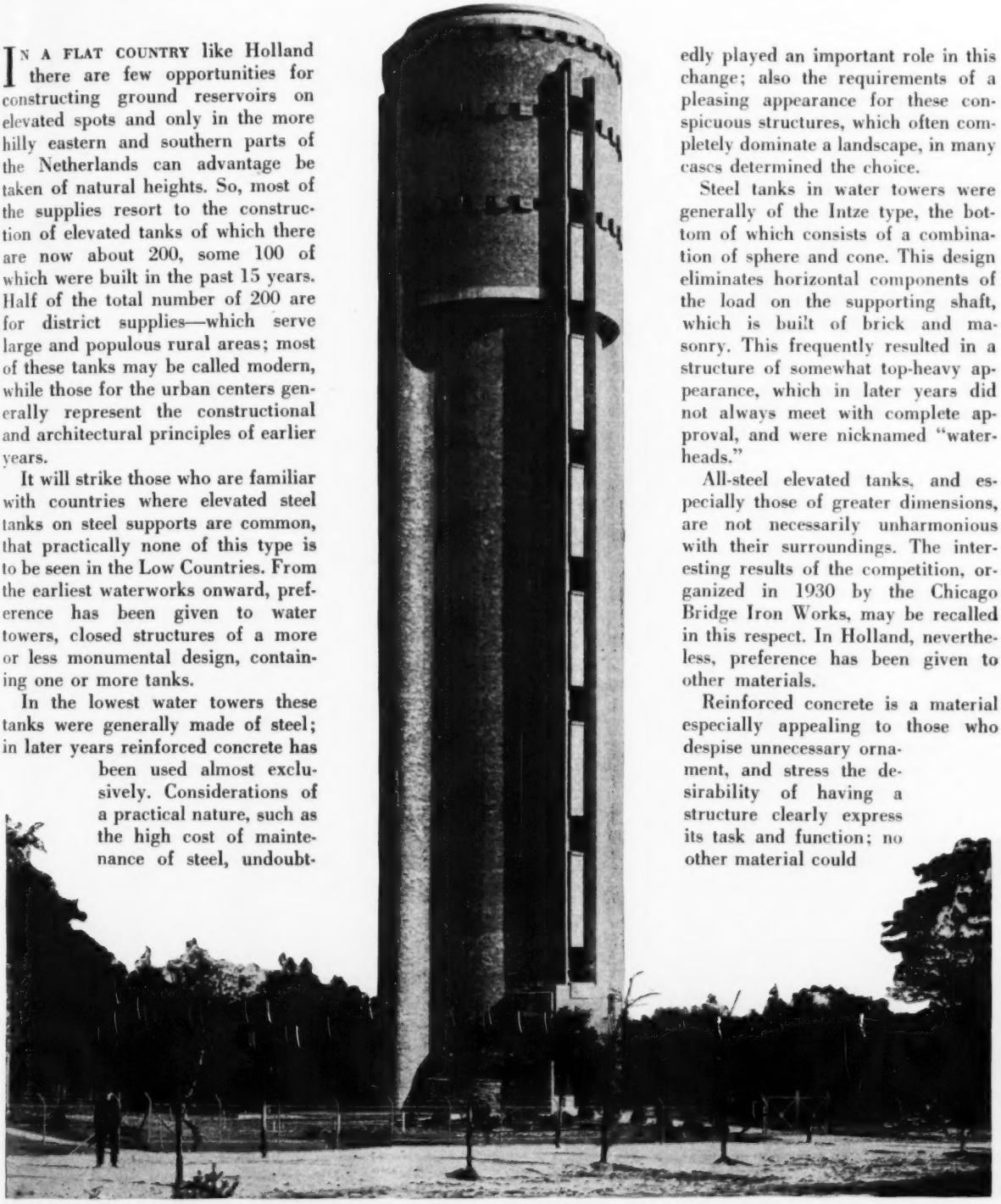
It will strike those who are familiar with countries where elevated steel tanks on steel supports are common, that practically none of this type is to be seen in the Low Countries. From the earliest waterworks onward, preference has been given to water towers, closed structures of a more or less monumental design, containing one or more tanks.

In the lowest water towers these tanks were generally made of steel; in later years reinforced concrete has been used almost exclusively. Considerations of a practical nature, such as the high cost of maintenance of steel, undoubtedly played an important role in this change; also the requirements of a pleasing appearance for these conspicuous structures, which often completely dominate a landscape, in many cases determined the choice.

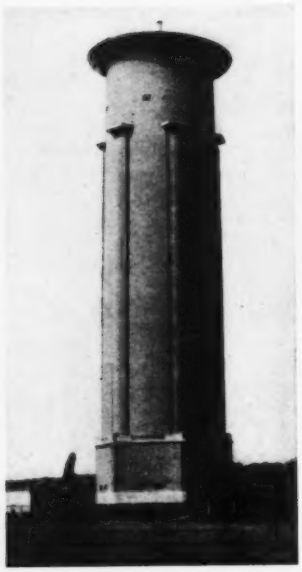
Steel tanks in water towers were generally of the Intze type, the bottom of which consists of a combination of sphere and cone. This design eliminates horizontal components of the load on the supporting shaft, which is built of brick and masonry. This frequently resulted in a structure of somewhat top-heavy appearance, which in later years did not always meet with complete approval, and were nicknamed "waterheads."

All-steel elevated tanks, and especially those of greater dimensions, are not necessarily unharmonious with their surroundings. The interesting results of the competition, organized in 1930 by the Chicago Bridge Iron Works, may be recalled in this respect. In Holland, nevertheless, preference has been given to other materials.

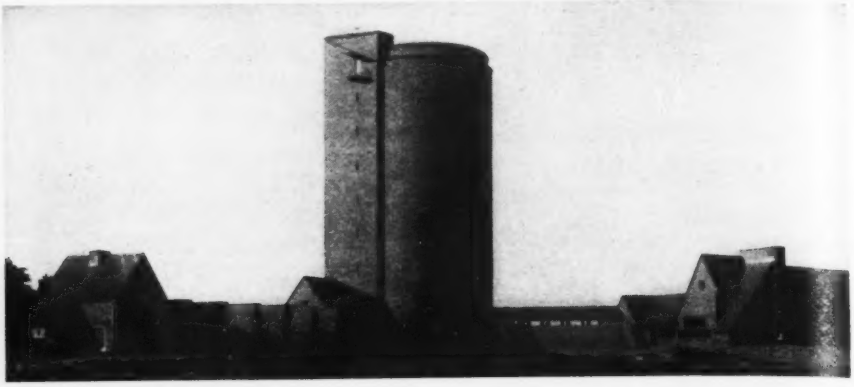
Reinforced concrete is a material especially appealing to those who despise unnecessary ornament, and stress the desirability of having a structure clearly express its task and function; no other material could



Water tower design for a residential area at Belthoven.



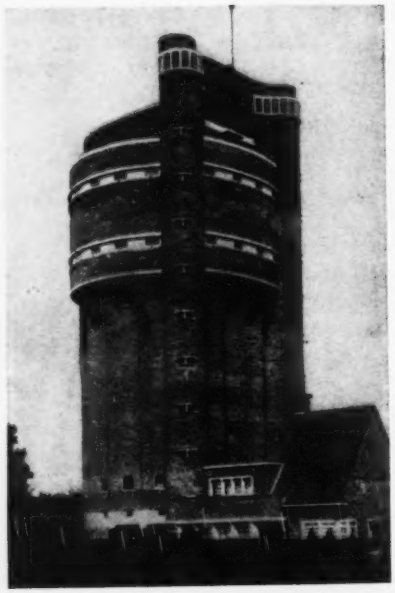
Standing alone in open flat country the tower at Lightmis is an impressively simple structure.



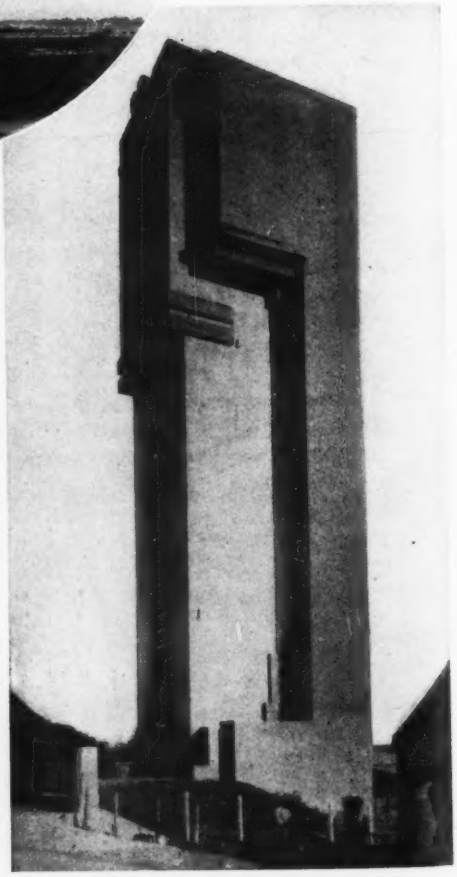
Combined with waterworks service buildings, this water tower is the dominant structure of the Laren waterworks.

Water tower at Breda (above) which was designed for a site in a public recreational area.

Built on the top of a dike is this modernistic tower (right) which is located at Fijnaart.



An observation platform and restaurant are located on the top of this picturesque water tower at Schimmert.



better emphasize the fundamental principle of the elevated tank, solidly supported by a not too immaterial substructure.

Architectural considerations

Several public water supplies in the Netherlands East Indies have erected tanks of reinforced concrete, resting on columns of the same material, which are completely satisfying to the eye. In a flat country like Holland the reservoirs generally must be placed high above the ground, and so, for practical reasons, and with a view to their conspicuousness, open substructures of reinforced concrete often had to be avoided.

Attempts have been made to erect high water towers of reinforced concrete while dispensing with costly scaffolding and using movable centering instead. The results, however, cannot be regarded as fully satisfactory from the architectural point of view, as perfectly cylindrical structures necessarily lack every possibility of interesting contrasts in light and shadow.

The majority of modern water towers in the Netherlands have one or more tanks of reinforced concrete, supported by columns of the same material, while the whole is more or less enclosed in a shell built of brick. The latter is a national product of high quality, which may be had in a great variety of shades, thus furnishing an additional element of architectural expression.

The functional parts of the structures thus are not always visible from the outside, which in some quarters is regarded as dishonest and therefore bad architecture. But designers console themselves with the thought that very few architectural structures, which serve special useful purposes, show all their structural and functional elements.

Uses for waste space

The considerable unoccupied space which high water towers necessarily contain underneath the tanks proper has challenged designers from the earliest waterworks onward. Pumping machinery and water purification apparatus have often been installed in this space. In one or two instances the personnel of the pumping plant with their families have been comfortably housed in the water towers.

Several towers, commanding a view much appreciated by tourists, have been provided with observation platforms, sometimes in combination with refreshment rooms or a cafe; in one instance a beautiful high spot was used for a building combining a hotel and the community water tower. Water towers forming part of a town hall are a feature not unknown in Germany; in one of the smaller communities of Holland the town council decided to hold its meetings in a room in the water tower, especially arranged for that purpose.

Engineering and esthetics

The design of water towers, as of other buildings of public utility, requires competence not only in the field of engineering but in esthetics as well. In some cases both abilities may be found in the same person; in a majority of instances a collaboration between engineer and architect has proved to be most desirable. Public authorities therefore have often tried to obtain the most satisfactory solution by organizing an open or restricted competition among qualified architects for designs which comply with the technical requirements indicated by waterworks engineers.

If one reviews the hundred-odd water towers, erected in Holland within the last 15 years, it goes without saying that not all will be found to possess equal architectural merit, nor will they be appreciated in the same way by different observers. From the pictures shown, however, the reader will obtain some idea of modern Dutch architecture in the service of a public utility. In judging the results, it should be borne in mind that in every case special requirements, which cannot be fully described here, influenced or determined the tower's appearance.

Retaining Wall Pressures and a New Theory

DETERMINATION of the magnitude and distribution of horizontal overturning forces acting on retaining walls due to loads applied on the surface of the backfill, rather than the forces imposed by the retained earth, has been the purpose of experimental study by M. G. Spangler, and reported in *Bulletin* 140 of the Iowa Engineering Experiment Station (Iowa State College). In these experiments, concentrated wheel loads of a heavily loaded truck on the surface created horizontal forces which were transmitted through gravel backfill to the retaining wall. The rear wheels rested on a heavy timber placed parallel to the wall and at varying distances from it. Pressure measurements on walls 6 ft. high and 15 ft. long were made by means of stainless steel friction ribbons and Goldbeck pressure cells.

It was found that measured pressures were distributed in accordance with the Boussinesq law of distribution of concentrated load through an elastic medium. But their magnitudes were two to three times as great as those calculated by the Boussinesq equations, the greater divergence occurring when the loads were applied close to the walls. More research is necessary to correlate the stress-distribution characteristics of various kinds of backfill material with physical properties of the soil, and also to determine the effect of the relative rigidity of the wall and backfill.

A new hypothesis of lateral earth pressures is put forward by Mr. Spangler, who states that remarkable qualitative resemblance was found between the horizontal pressure distribution caused by concentrated surface loads or line loads and the distribution indicated by the Boussinesq equations for stress distribution in an elastic solid. On this basis he suggests a new approach to the problem of retaining wall pressures due to backfill materials. "In such an hypothesis, the weight of each small incremental volume of backfill material might be considered to be a concentrated load which would transmit a horizontal pressure to a retaining wall through the mass of fill material lying below the increment. The sum of the horizontal pressures due to all such increments of volume above any point on a retaining wall would be the pressure on the wall at that point. This proposition indicates that the pressure on the wall may be affected by the distance which the backfill extends back of the wall to a much greater extent than is indicated by the orthodox wedge theories."

FROM FIELD AND OFFICE

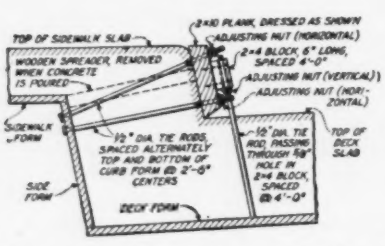
Working problems and time-saving methods . . . Edited by Charles S. Hill

Adjustable Bridge Curb Form

BERNARD F. PERRY
New York State Division of Highways, Rochester, N. Y.

On a four-lane truss bridge near Rochester, N. Y., it was necessary to pour the deck slab, curbs and cantilevered sidewalks monolithically. Since the top of the slab was to be the finished pavement wearing surface, the design of the deck forms was governed by deflection. However, if a smooth grade was to be obtained on the curb, which would be pleasing to the eye, some means of adjusting the curb forms was necessary after the maximum deflection of the deck forms was attained. It was also necessary, as the accompanying sketch shows, to support the curb form which literally hung in the air.

A 2x10-in. plank was cut to the required depth of curb, and the top was bevelled slightly to permit accurate screeding of the sidewalk which sloped to the curb, and properly to finish the curb itself. The bottom of the form was bevelled sharply to permit finishing the concrete underneath. The flat sides of 2x4-in. blocks, 6 in. long, and with a $\frac{5}{8}$ in. hole drilled through the thickest edges, were nailed to the curb form about every 4 ft. Through the $\frac{5}{8}$ in. holes, $\frac{1}{2}$ in. rods, threaded on one end, were inserted. The bottoms of these rods rested on the deck forms, and by means of nuts on the threaded portions, bearing against the bottoms of the 2x4-in. blocks, they supported the curb form in its proper position. Any adjusting of the form could be done by turning the nuts, either raising or lowering, as the individual case required.


2x10 PLANK, DRESSED AS SHOWN
ADJUSTING NUT (HORIZONTAL)
TOP OF SIDEWALK SLAB
WOODEN SPREADER, REMOVED WHEN CONCRETE IS POURED
2x4 BLOCK, 6" LONG, SPACED 4'-0"
ADJUSTING NUT (VERTICAL)
ADJUSTING NUT (HORIZONTAL)
SIDEWALK FORM
½" DIA. TIE RODS, SPACED ALTERNATELY TOP AND BOTTOM OF CURB FORM @ 2'-0" CENTERS
½" DIA. TIE ROD, PASSING THROUGH ⅝" HOLE IN 2x4 BLOCK, SPACED @ 4'-0"
TOP OF DECK SLAB
SIDE FORM
DECK FORM

Section showing arrangement of adjustable form for bridge curb.

Horizontal alignment was obtained by the rods, threaded at one end, and passing through the curb forms. These rods were spaced about 2½ ft. apart, alternately in the top and bottom of the form, in order to maintain the proper batter. By means of nuts on the threaded portions of the rods on the front side of the curb forms, any adjustment could be made to obtain the required straight line.

Immediately after concrete was placed in the forms and before finishing, the forms were checked as to line and grade and any necessary adjustments made. When the forms were stripped, all tie rods were easily pulled out and the holes filled with grout. The results obtained were highly satisfactory and thoroughly justified the small amount of extra work required.

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Typing on Tracing Cloth

HOMER W. KRATTLY
Harrison, Ark.

Time can be saved in the drafting office by typing notes and legends on cloth tracings instead of hand lettering them, when considerable information is to be presented.

1. Outline the area to be typed with a soft pencil on the dull side of the tracing.

2. Remove the gloss from the glossy side of the tracing within the outlined area by an erasing machine using a soft rubber eraser in the holder, or by an ordinary ink eraser. The erasing should be done lightly so that only the gloss is removed without injuring the preparation on the linen, or the linen itself.

3. Place the tracing in the typewriter "carbon backed" so that the carbon side of the carbon paper is against the portion of the tracing which has had the gloss removed.

4. Double-type the information onto the dull side of the tracing. This can best be done by typing a line, then returning the carriage to the initial position and typing over the already typed information.

If desired, the information can be double-typed, triple-typed or better, but with the carbon on the back of the tracing cloth secured by carbon-backing, very satisfactory blue printing results have been obtained from double-typing alone.

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Three Duty Test Drill Rig

WAYNE W. LINTHACUM
Billings, Mont.

The test drill rig illustrated was designed by the writer in 1937 and combines a test drill with a rotary spudder and wash-bore attachments.

The drill has a welded framework small enough to fit in a ½-ton pickup truck and a 14-ft. welded derrick which is removed when traveling any distance; the rest of the unit is bolted

Truck-mounted three-duty test drill rig.

construction. It is powered with a 5 hp. air-cooled gasoline engine equipped with a speed reducer and an automobile type transmission direct in line. Chain drives are used from the transmission to the spudding wheel, rotary and hoisting shafts. The spudding wheel and rotary drive are interchangeable on the same shaft, so designed that very little work is required in changing. A piston type, vee-belt-drive 1-in. water pump is used when washboring with the machine.

When used as a spudder (see picture) the ½-in. steel line is strung the same as on a large machine and a

spring-mounted crown pulley absorbs the shock of the tools. The spudder wheel has three eccentric adjustments for length of stroke. The transmission gives a variety of speeds for both spudding wheel and hoisting drums.

For rotary work a chain drive rotary table is mounted in the machine and turns a 2-in. square "kelly bar." Two sizes of right hand soil augers, 9 in. and a 12 in. are used. A 2 in. double-extra-strong, square-thread pipe in 5-ft. sections is used for drill stem. The drilling cable is the same as used on the spudder, but is strung directly over the spring mounted crown pulley. The working depth of the rotary is about 50 ft.

When washboring, the pump forces water through a water swivel head to a 1-in. jetting spade encased in a 2-in. standard pipe casing. The water swivel is hung from the $\frac{3}{8}$ in. steel line and the casing is driven down with a 150-lb. hammer on the spudding line.

A complete crew consists of an operator and two helpers. An average run for the rotary or spudder is about 30 ft. a day.

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Exceptional Wood Pile Record

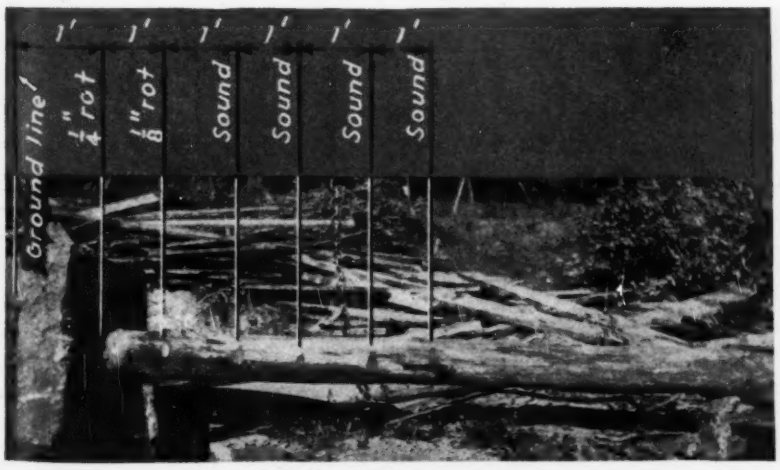
N. B. GARVER
Arkansas State Highway Commission, Little Rock, Ark.

The durability of untreated timber foundation piles has been largely a matter of conjecture, especially when part of the time the tops are above the ground-water level. Recently the opportunity was afforded to examine such piles in reconstructing the bridge over Bayou Bartholomew on U. S. Highway No. 79 in Jefferson County, Arkansas. The old bridge built in 1902, had five 18-ft. steel spans carried on steel bents resting on concrete footings, and one 70-ft. steel pony truss carried on steel cylinder piers.

After the wood floor and deck steel had been removed from the beam approach, lines from the derrick were hitched to the steel legs of the bents and they, with the thin concrete footings attached, were lifted from their positions. When this was done it was found that under the center of each footing, which was 3x3 ft. and 10 in. thick, was a white-oak pile varying in length from 10 to 12 ft. and in diameter at the butt from 8 to 10 in. In several instances these piles were lifted out of the ground with the concrete footing, as shown by the accompanying illustration.

The water in the stream, at times covers the ground where the piles were located, but most of the year it is confined to the channel of the stream; at low water the water surface is 6.8 below the tops of the piles. An examination of several of the piles shows that there is decay to a depth of $\frac{1}{4}$ in. to 1 in. at a depth of 1 ft. below ground, about one half that amount at 2 ft. below ground, and no decay 3 ft. below ground. Bark fibers still cling to the piles at a depth of 4 ft. below ground. The soil is loose sandy clay near the surface changing to firm sandy clay underneath.

The above facts, together with numerous other observations which have been made during excavations for underpasses in railroad embankments where timber trestles have been buried for many years, lead to the opinion: That untreated timber piles embedded in moist soil to such depth that air does not penetrate, will last indefinitely, although the tops of the piles may be several feet above ground-water level.



Rot in a pile after 36 years in occasionally wet ground.

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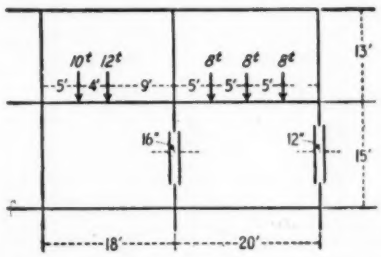
Simpler Dimension Marks

OTTO GOTTSCHALK
Buenos Aires, Argentine

Technical plans may be improved considerably by using dashes in place of the conventional arrowheads for marking distances and dimensions, leaving the arrowheads to indicate details of definite direction like inclines, loads, stresses, currents and linear or angular displacements.



Dashes mark dimensions and arrows mark loads.

The sketch shows a typical skeleton, in which the lengths and dimensions are fully determined by simple dashes; cross dashes would not add any clearness or information and therefore are superfluous and better omitted. This not only means a relief in a days' work of drafting, but makes the loads, reactions and directions to which arrowheads are applied as usual stand out clear. In diagrams of structural analysis this differentiation between inert lengths and acting stresses or displacements becomes ever more necessary. Those using inclined dashes for two weeks will find it an effort to return to arrowheads for marking distances and dimensions; in technical illustrations especially, where much information has to be crowded into small figures, they will add greatly to clearness.

Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

COAGULATION—From time to time attention has been called to the clarification of sewage by certain bacteria and protozoa. Different types of bacteria have varying clarification powers. The faculty of clarification by these organisms is especially important in polluted streams and in the activated sludge process. That certain protozoa are capable of increasing the floc formation in addition to destroying a certain amount of organic matter has been demonstrated in mixed cultures. Jäger (*Zeitschrift fur Hygiene und Infektions Krankheiten*, 620, 1938) has now shown that the flocculation of sewage colloidal substances is stimulated by certain pure cultures of these unicellular animals. A pure culture of *Paramaecium*, for instance, in the presence of bacteria produced practically the same rate of purification as a mixed culture of different protozoa and bacteria. Other protozoa do good work only when the sewage is partially purified.

DIGESTION FOR MILK WASTE—Milk waste treatment for small dairy plants continues to be a problem. Cost of treatment plant construction should be low, maintenance cost must be small and operation should be simple. To meet these conditions, Plock (*Molkerei Zeitung*, 313, 1938) describes a plant using a series of tanks sufficiently large to hold the waste for a period of twelve days. Each tank is large enough to accommodate the waste from one day's operation. Most of the solids settle in the first four tanks where the milk sugars and casein are decomposed anaerobically. Although the basins are separated by dividing walls, they are built to permit sludge communication near the bottom of the tanks. The milk sugars are reduced to acids in 24 hours, the casein and other organic materials are reduced to ammonia in two days, and further stabilization is claimed to take place in 8 to 9 days of subsequent storage. Fresh water is mixed with the effluent in the last tank. Milk wastes with oxygen consumed values of 1,500 p.p.m. are fit for surface irrigation of land.

TRICKLING FILTER FILM—The effectiveness of purification by trickling filters is directly related to the active biological film on the stones. This is illustrated by the fact that it requires some time before the filter bed "ripens." Following this there is a direct proportional relation between the amount of film and the load which can be handled. However, when the film remains in the bed for a time it changes to a humus-like material which is not so active and consequently the rate of purification decreases. This can be note particularly before and after sloughing. Ponninger (*Gesundheits Ingenieur*, 596, 1938) believes from experimentation on large filters, that the remarkable difference between active film and humus (aside from biological activities) is due to the fact that inactive humus repels water and the contact time is reduced; active biological film on the other hand, absorbs water greedily, allows penetration and contact with the organisms and increases the time of contact. This confirms the findings that the amount of active film is more important than the quantity of filter material. It also explains why with somewhat larger stone the purification is not materially less than with smaller material. With large size filter medium the surface area of the film should be somewhat less and theoretically, therefore, it would be assumed that the degree of purification is lessened.

SULFIDE ORGANISMS—Odors emanating from septic sewage and from sewers is caused principally by hydrogen sulfide. This is produced by bacterial decomposition of organic matter and sulfate salts. The reduction of sulfate to sulfide is a reaction brought about by a small group of specific bacteria, which are widely distributed and intensely active under favorable conditions. Since they were first discovered by Beijerinck in 1905 in canal mud these bacteria have been identified in many substances including sewage solids, ocean mud and sand. It appeared that the organisms were strictly anaerobic and possibly belong only to one species.

Starkey (*Archiv fur Mikrobiologie*, 268, 1938) now reports the isolation of an anaerobic organism (*Vibrio desulfurican*) from raw sewage, mud and soil which is active at mesophilic and thermophilic temperature ranges. The organism is capable of producing spores and when transformed from lower to higher temperatures readily adapts itself. It is possible that this organism is the main offender in causing odors and likewise affects sulfide production which causes sewer pipe destruction as well as corrosion of iron pipes placed in soils. Having this basic information it may be possible to develop effective methods to reduce, retard or inhibit the action of these organisms.

CLOSED FILTERS—Artificial aeration of closed trickling filters, which are able to handle a higher dosage, are claimed to have several other advantages. Ponninger (Beiheft 18 Series II, *Gesundheits Ingeneur* 1938) using experimental units, studied the questions whether (1) enclosing and artificial aeration of filters would eliminate odor and fly nuisances, (2) if pooling and clogging could be prevented by using high rates of flow and (3) what purification could be accomplished. The sewage used was very strong and for these conditions the general conclusion is reached that enclosed, artificial aerated filters are preferred over open filters. The unusual conditions encountered (strong sewage, trade waste and close proximity of houses) made it necessary to prevent nuisances and troubles so that this method is favored, but this does not mean that under ordinary conditions this type of treatment is economically sound. In specific cases, especially where strong organic industrial wastes must be oxidized to a rather high degree, the method of treatment appears to be of considerable interest.